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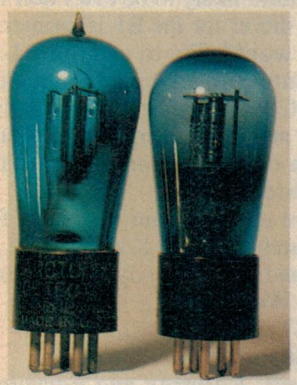
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UV 'scopes in space...



Earlier this year, NASA's STS-67 mission saw shuttle Endeavour orbiting with a suite of hi-tech ultraviolet telescopes, which scanned the universe for signs of stars being 'born' or 'dying'. Kate Doolan explains, in her story starting on page 26.

When AC came to valves



The first domestic radios operated from batteries; it was not until the late 1920s that the arrival of indirectly heated valves allowed mains operation. Peter Lankshear explains how it happened — see page 100.

On the cover

Model trains are popular, but you really need an electronic controller to achieve smooth and realistic train operation. The controller doesn't have to be complex or expensive though, as Graham Cattley's new design demonstrates. It's described in his article, starting on page 62. (Photos by Phil Aynsley)

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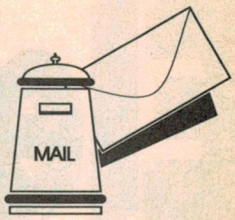
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LETTERS TO THE EDITOR



Instrument data?

I have noticed from time to time, that you assist readers in tracing service data etc., for 'dated' or otherwise hard to obtain equipment.

If I may impose on you just this once, to ask you for assistance by communicating with your readers about the following equipment which has come into my possession recently, and for which I have been unsuccessful in getting service data. Perhaps one of your readers might be able to help?

1. Frequency Counter/Timer, Advance Instruments, Model: TC11

I understand that this equipment used to be serviced by Jacoby Mitchell, of Sydney which is no longer in business.

2. Signal Generator, Trio, Model: AG203

If anyone can help with a copy of relevant service data for the above equipment, it would be greatly appreciated. Any cost will be cheerfully paid.

Many thanks for your assistance, and your time. Please direct all communication to the address below.

Mr Jonah Bancroft,
Unit 5, 14 McClares Road,
Vermont, Vic. 3133.
Phone (03) 9874 6825.

Razor-blade radio

In response to William Donaldson's letter in the August issue requesting information on the workings of a WWII razor-blade radio, I'm sure he'll be glad to know that an article has already been published in *EA* describing just such a unit. The article is 'Build this simple World War Wireless' by Penn Clower W1BG, and appeared in the January 1986 edition of *EA*.

The article certainly makes very interesting reading, even for a 'raised in the eighties' digital hobbyist like myself too! I'd certainly like to see more articles along the same lines.

David L. Jones,
Advanced R&D Solutions
Lethbridge Park, NSW.

PCB printing problem

A short time ago I downloaded the Easytrax (Ver 2.06) PCB layout program from the *Electronics Australia* BBS and I like using it to lay out PCBs. Thank you for making it available. However I have had some trouble using the Easyplot (Ver 2.06) software to drive my Canon BJ-10sx printer.

At first I tried moving the Canon printer drivers (which came on disk) into the Easytrax directory and reading them from Easyplot, but they did not appear. So I viewed the drivers and found that all of them can only be used in Windows.

As the BJ-10sx can be set to work as an Epson printer, I set the Easyplot software to Epson 8" and printed a PCB. It did print, but in very poor quality. I know the BJ-10 can do better, as I use it with MS-Publisher with very good results (at 360dpi).

I have spoken to Canon (in N.Z.) but they just said that the software is incompatible with the BJ-10 and suggested I buy a laser printer. I feel that the problem is more likely to be that I don't have a DOS driver for the BJ-10 printer.

As I would like to use the BJ-10 to print onto transparencies to make my own PCBs, I need to find a solution to this and I am hoping that you may be able to help me or point me in the right direction.

I have enjoyed your magazine for 14 years and still do. Keep up the good work. and I will happily pay more for it.

Kim Welch,
One Tree Hill,
Auckland, NZ.

Comment: Easytrax and Easyplot are excellent programs, Kim, but as you've found they're DOS based and use their own custom drivers for video cards and printers. And because Protel Technology now regards them as obsolete, no further printer drivers are likely to appear. In fact when Protel made them available as public domain 'freeware', they understandably stopped supporting them. So your chances of getting better quality printout with a BJ-10 are not good, unless perhaps you can get hold of a DOS-based PostScript driver for it (Easyplot will produce high quality PostScript). Of course Protel's current packages are all Windows based, and can take advantage of all of its

Windows based, and can take advantage of all of its drivers.

IRIS Codes

This letter serves to confirm that Sony Australia at no time stated we would supply copies of IRIS codes as mentioned in the recent article in the August issue of your magazine. Sony has received many phone calls enquiring about their free copy, which has caused us some embarrassment. At the moment we are only using the IRIS codes to record our own fault details, which involves our Authorised Sony Service Centres only.

Would you please pass this information on to any of your readers who have been given the wrong information. Thank you.

Derek Horner,
National Service Manager,
Sony Australia Ltd,
North Ryde, NSW

Valve era parts

I have accumulated a lot of valve era components, including valves, transformers, switches, tuning coils, variable condensers etc. etc., as well as some hundreds of issues of your magazine, dating from the days when it first used the title *Radio and Hobbies*.

I have no further use for this equipment, and in view of the re-awakening interest in valve techniques, I would be please to give it all to an interested amateur rather than take it to the dump.

I would be obliged if you could find space in *Electronics Australia* to notify any of your Canberra-area readers who may be interested.

I can be phoned on (06) 286 6243.

John Graham,
Canberra, ACT.

Happy DMM winner

I write to thank both Electronics Australia and Hewlett-Packard for the wonderful prize of a HP973A digital multimeter which I won in your recent subscription promotion.

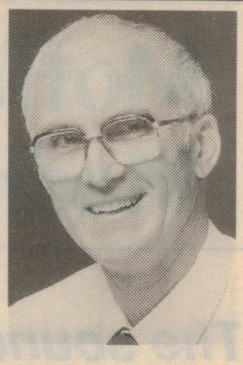
I am absolutely delighted with it. It will help me greatly with my electronics projects, which I work on when I am not sugar cane farming.

Thank you so very much again.

Joe Markotich,
Gordonvale, Nth Qld.

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We reserve the right to edit letters which are very long or potentially defamatory.

EDITORIAL VIEWPOINT



When is EA likely to appear on CD-ROM?

I've been asked this question quite a bit lately, along with the related question of when we might begin publishing the magazine as pages on the World Wide Web. I guess both questions are inevitable, in view of the current hype about the developing 'multimedia revolution' and about the Internet as a precursor to the future global 'information superhighway'.

It's understandable too that people will expect more pioneering in this area from a 'high tech' magazine like *EA*, than from one devoted to say cooking, fishing or gardening. Our readers are much more aware of the new technology, for a start.

So why *haven't* we burst forth in full multimedia splendour yet, on CD-ROM or the Web? Because there's a bit more to it than that. Although in the future many conventional printed-on-paper magazines (and books) will undoubtedly make the transition to a 'multimedia' format, and be delivered to their consumers in either interactive on-line form or via a 'canned' medium such as CD-ROM, this won't necessarily apply to ALL magazines or books — at least in the same way, or with the same timetable.

In the book area, for example, it's now fairly clear that 'reference' books like dictionaries, encyclopedias, atlases and directories are making the transition first, because interactive electronic delivery has clear advantages over the printed medium in terms of the way these books are actually used. But novels and poetry books are quite different, and will probably remain in printed form for much longer — if not indefinitely.

With magazines, the situation is actually quite complex. Although a magazine like *EA* deals with 'high tech' and therefore may seem an ideal candidate for interactive electronic publishing, by our very nature we're catering for a relatively small 'niche' market. Despite worrying rises in paper costs, we're able to survive and remain viable because production in our present form can be achieved quite economically using desktop publishing and a relatively small staff. If we were to try publishing the entire magazine in interactive electronic form every month, we'd probably need to double the staff and add quite a lot more computer hardware and software. (Interactive media are produced more like movies than magazines.) This would result in a dramatic increase in costs.

On the other hand, the number of readers who are equipped to 'read' the magazine in fully interactive electronic form is probably quite small, as yet. So for some time to come, we couldn't expect to get more than a token return from this big investment. (With *on-line* publishing, there's a further problem in that as yet, no-one seems to have discovered a reliable way to make much money from it.)

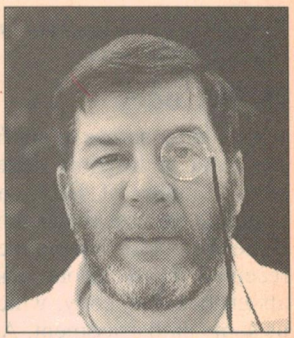
It's also quite possible that once the novelty wore off, at least some readers might prefer to stick with or return to the magazine in printed form — it might well still meet their needs better.

So does this all mean that we're *never* going to 'go digital', and have decided to stay in our present 'old fashioned' form indefinitely? No, not at all. The tremendous success of our Reader Service computer BBS has shown that while full-scale electronic publishing of *EA* might not be feasible for some time, a more limited operation may well be. In any case, we need to get experience in the new media and formats. So don't be surprised if before long, we start offering you some interesting electronic options.

Jim Rowe

Moffat's Madhouse...

by TOM MOFFAT



The sounds of silence...

This year marks the fiftieth anniversary of the first atomic bomb test, at Trinity site in the New Mexico desert. As we all know the success of that test forced a rather brutal end to the Japanese contribution to World War II. It also opened the door for further nuclear tests, which only ended many years later with the establishment of the Nuclear Non-Proliferation Treaty.

So now it is time to introduce you to another one of the wonderful characters who sometimes inhabit Moffat's Madhouse. You may remember Flubby the Wonder Technician. You may remember Jim the reluctant antenna installer ('passive repeaters'). Now may we present — Walt Treibel, electro-mechanical engineer extraordinaire, who personally let off 31 atomic bombs, one of them twice. Huh!? Read on...

Six years after Trinity, scientists from Los Alamos and Sandia National Labs had progressed to a series of tests of 'small' bombs — about one kiloton or so — to determine whether the most useful experimental data could come from bombs detonated on top of a tower, on the surface, or underground. October 19, 1951 was the date chosen for the first tower test at the Nevada Test Site, which still exists to this day about 100km northwest of Las Vegas.

An hour before 'shot time', three engineers, led by Walt Treibel, began the bomb arming sequence. Their first job was to lock open a series of switches that isolated the bomb from signal lines coming from the control point 10 miles away. This was to prevent the embarrassment of being blown to smithereens by someone pressing the 'big red button' back at the control point before the scheduled time.

With the bomb 'safe' (or as safe as one of these things can get), the crew then climbed a ladder to the top of the 100 foot tower wherein rested the bomb — a five-foot diameter cylinder mounted on two-foot legs. (Sorry about all the imperial measurements, but that's what they used back then.)

The main act of 'arming' consisted of physically connecting the bomb to the outside world by a big fat cable with a multi-pin Amphenol connector on each end. These were the standard military-issue connectors back then, in fact they remain in use today. One end of the cable went into a socket on an electronics rack; the other end was then connected, very gingerly, to a socket on the bomb itself.

With that little job completed the three men tip-toed their way back down the ladder and headed back to the switching hut — two miles from ground zero — to re-connect the signal lines from the control point. Then, their job done, they drove to a small hill next to the control point to watch the fireworks display.

The countdown

Zero hour soon arrived, and a countdown began. ''Ten, nine, eight, seven, six, five, four, three, two, one, FIRE!'

Nothing. Silence... The bomb was a dud, a fizzer. Then the countdown controller yelled "MISFIRE! There's been a misfire!! Hold your positions! Hold your positions!" And Walt Treibel started thinking: Is it alive? Is there a relay stuck that might give way any second?

Well, Treibel wasn't going to have to wait too long to find out. Test director Dr Al Graves soon emerged from the control building and said, "Treibel, you put that thing up there. You go get it down!" But Walt Treibel already knew that would be his job. Maybe his *last* job. "I thought that was terrible, because I knew we were going to be involved in rescuing the thing or getting blown up — one or the other."

Treibel and the other two engineers immediately began working out a plan of action. They started writing down an outline of what needed to be done, what they needed to look for as evidence of what caused the misfire. It was a very careful, and very important plan. Because if it wasn't carried out correctly — oooh, you can't bear thinking about it.

"When the time came, we nodded to our friends. We weren't sure we'd see them again..."

The team got into a car and drove toward the tower, sitting there silent and sinister. As they drove along they put down the car's sun visors so they wouldn't be blinded if the bomb suddenly went off.

They stopped again at the switching hut and once again opened the signal links back to the control point. Then it was back into the car for the final (not a real good word there) leg of the journey. The sun visors went back up; they realised that if the bomb went off at this stage, blindness would be the least of their worries.

Soon they reached the bottom of the tower. The bomb was silently sulking a hundred feet above their heads, and they were going to have to go meet it face to face.

You've got to use some imagination here to visualise the scene. A big four-legged tower made of steel lattice work. Until that day there had been a little lift running up to the hut on top where the bomb is installed. But the lift had been removed; you wouldn't want to waste a perfectly good lift by vaporising it. So now there was just a ladder reaching 100 feet straight up...

If you picked up a big stone, walked over to one leg, and gave it a bash, the whole tower would ring like a bell. If you walked to the ladder and just gave it a good thump with the palm of the hand, it would resonate and vibrate strongly.

Treibel was still thinking about relays: What if one of the relays in the bomb hut had a *tiny* grain of sand between the contacts, and what if footsteps on the ladder got the tower

vibrating, and what if the grain of sand fell out, allowing the contacts to close properly...?

"I don't recall who went up the ladder first. It didn't matter anyway. We were a team, and we'd agreed right up front that nothing would occur without the concurrence of all. We stopped a lot on the ladder to catch our breaths because of the anxiety, and because of our awareness that each step could be our last."

Visualise again: tip-toeing up that ladder, softly-softly, but the tower still going bong, bong, with every step. I wonder if they took their shoes off? I would have taken MY shoes off. No I wouldn't — because I wouldn't have been there in the first place! I most likely would have been high-tailing it across that desert toward Las Vegas, at a great rate of knots...

"Finally we reached the hut containing the device. We were careful not to disturb anything; we just looked at the voltmeters in the relay racks. Dead. No voltage was going into the unit (test-site language for bomb). But it still could have been charged."

So what to do? The power panel looked dead, which might be a good thing. But maybe the 'unit' got a good charge of power before the power went off? Maybe it was just waiting to let it rip with just one little nudge to a relay.

There was only one thing to do; that cable between the power panel and the bomb had to come out.

Now anyone who has ever used one of those big Amphenol connectors knows that you don't just grip it between two fingers and gently twist it free. Those connectors are meant to STAY connected, and some have rubber seals that are compressed to make them waterproof. So you really have to get two hands around one of the big connectors and give its collar a good twist. This is not normally a gentle process.

So, holding his breath and with heart racing, Walt Treibel got his hands around the connector and gave it a good twist. And out it popped!

"We all rested a lot easier when that cable came out."

Investigation revealed that no electrical power had ever reached the unit. Amphenol connectors have a keyway, a little metal protrusion, that fits into a similar slot on the socket. This is to ensure that the plug can only be inserted the correct way. There is another keyway linking the plug and its backshell, so that the backshell and its cable clamp cannot be rotated in relation to the plug.

It appeared that on the plug that went into the bomb, an insert had shrunk, allowing the guts of the plug to rotate in relation to the cable — shorting out all the wires. This caused the power fuses to blow, totally disabling the 28 volt supply needed to detonate the bomb.

To cut a long story short, a new cable was soon made up, and the bomb was successfully detonated three days after the misfire. But that errant cable led to some design changes. From then on, the inserts in Amphenol connectors used at the Nevada Test Site were molded into the connector shells, so that it was impossible for them to rotate. As well, a lot more telemetry circuits were provided back to the control point, so it was possible to read things like voltmeters without having to risk instant death climbing the tower...



Walt Treibel, now retired, enjoys a copy of an illustrious magazine...

Now retired

Today Walt Treibel is living in retirement in Albuquerque, New Mexico, where he spent so many years working for Sandia National Labs. He's developed a talent for restoring electronic 'classics' such as a 1950's RCA colour TV (the original model with the round screen).

And it wasn't just a museum curiosity; until very recently Walt Treibel had that television in daily use, it was his only set. He also rebuilt a top-of-the-line MacIntosh stereo amplifier and preamplifier combination — 1960's vintage and all valve.

As for atomic bomb tests, they have become socially unacceptable of late because of the nasties they release into the environment. Walt Treibel spent most of his working life with atomic devices, and he has now paid the price — cancer, and the loss of one leg. But he can still get around all right in his modified four-wheel-drive, spending his days visiting his old cronies and talking about the good old days at Sandia Labs.

Looking back to 1951: Instead of climbing up there and disarming that bomb, wouldn't have it been easier to turn around and run like hell?

"It would have been a lot easier, but we didn't. In those days when you worked for somebody like Dr Graves, he was in full command and you did what he requested."

Even laying your life on the line? "Well we didn't really look at it like that. We just went ahead and did it, you know..."

But today, if Dr Graves said to go up to the tower, and disconnect the bomb, and bring it down?

"Back then, I said 'Yes Sir!'. But if I'd known then what I know today, I'd have said 'Jump in the river!'" ❖

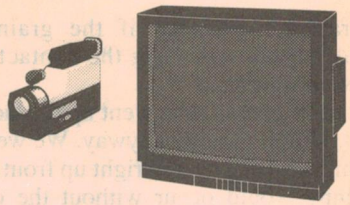
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What's New in VIDEO and AUDIO



3D stereoscopic eyewear

The new StereoGraphics CrystalEYES Active Eyewear System is a high quality, affordable solution to viewing of 3D projected video images. Distributed through Electro-home as a natural complement to their 3D stereoscopic video projectors, the Active Eyewear System delivers realistic, high resolution colour images for dramatically increasing the impact of video presentations and entertainment.

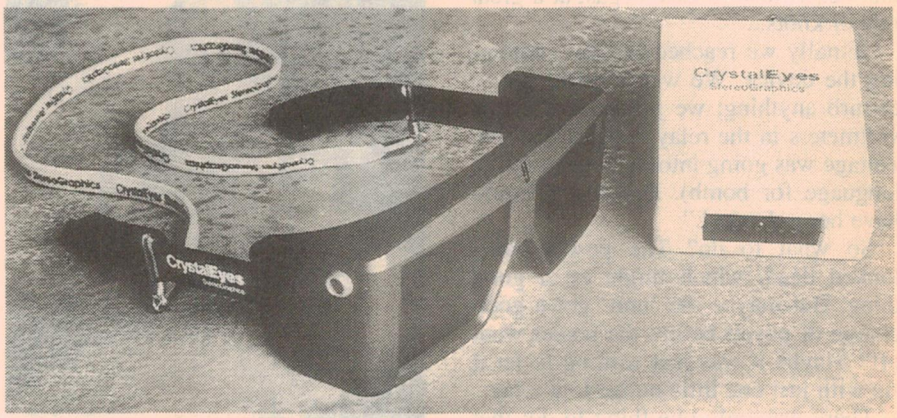
The system is designed for a host of real world applications including dramatic stereo video entertainment, architectural walk-through presentations, flight simulation, computer CAD and graphics animation, scientific and medical visualisation, physical modelling and photogrammetric mapping.

The system employs state of the art liquid crystal shutters which switch the image to each eye 60 times per second in synchronisation with the alternating left and right eye views of the projected video image. As a result, each eye sees the image with its own perspective.

No connection cables are used. An infrared emitter transmits synchronisation signals to any number of viewers simultaneously, with complete freedom of movement, up to six metres away. Additional slave emitters may be added to increase the coverage area.

With a weight of only 85 grams, the Eyewear is as comfortable as a pair of eyeglasses. Standard batteries provide over 200 hours of operation, extended by an automatic power down after eight minutes of non-use.

For further information circle 181 on the reader service coupon or contact Amber Technology, 5 Skyline Place, Frenchs Forest 2086; phone (02) 9975 1211.



VHS-C camcorders have 'widescope' colour finder

Panasonic's recently released range of compact and slim VHS-C camcorders includes a model to suit every amateur video enthusiast's needs. The range consists of five new models, ranging from the fully automatic A3 to the R55 with colour viewfinder and digital effects.

All models are constructed from a one piece aluminium die-cast chassis for durability. They all have auto date recording, large on-screen display, single switch start and are compact and light weight.

The range begins with the A3, which is designed for a user who wants a video camera that is easy to use and uncomplicated. The A3 replaces the successful A1, with the additional feature of manual focus and one lux low light shooting which is ideal for recording indoor events.

The next model in the range is the A5, a full automatic which has all the features of the A3 camera with the addition of a high resolution colour viewfinder with AV widescope.

The AV widescope attaches to the viewfinder and enlarges the picture by 2:1, allowing the user to hold the camera away from the eye.

For the user who wants greater creative flexibility there are three 'R' series cameras, the R11 Wide Angle Lens Camcorder, R33 Hi-Fi Stereo Camcorder and R55 with digital functions and Colour Viewfinder.

The top of the range R55 has a colour viewfinder, and an AV widescope. It also includes six digital functions: 60 x Digital Zoom, Digital Wipe, Digital Mix, Digital Gain-up, Digital Strobe and Digital Snapshot which allow the user to add many creative elements to any video production.

The new Panasonic video cameras are available from leading retailers, with RRP levels ranging from $1499 to $2199.



New mini systems from Sony



Sony Australia has released two mini component systems for people who require small and flexible systems without compromising on features or sound quality.

Both the MHC-EX5 and MHC-EX9AV systems feature a single disc CD player, twin auto-reverse cassette deck, 30 preset AM/FM tuner, amplifier and full function remote control.

The MHC-EX5 has 50W per channel which powers the three way time aligned speakers with 17cm bass drivers. It also features Source Direct, which bypasses all tone controls and unnecessary circuitry for pure signal playback. Other features include Dolby B & C, feather touch controls, digital output, auxiliary inputs, CD synchro record and AV shielded speakers.

The MHC-EX5 has an RRP of $1499.

The MHC-EX9AV delivers 70W to its three way time aligned speakers with 17cm bass drivers, as well as its 28W centre channel and 10W for the rear channel speakers. It has the same features as the MHC-EX5, with the addition of Dolby Pro Logic Surround Sound which allows users to create a surround sound effect by using the supplied centre and rear channel speakers.

Kenwood MD changer for cars

Kenwood's new KMD-C80 MiniDisc changer is designed to be configured with any compatible MiniDisc Changer Control unit.

Designed for boot or behind rear seat installation, the KMD-C80 can be mounted horizontally or vertically and being small can even be installed in a centre arm console. It employs built-in digital anti-skip memory, so that even if the road is rough the music will not be interrupted. The KMD-C80 employs Kenwood's proprietary four one bit D/A conversion technology with eight times oversampling and 64 times fourth-order noise shaping circuitry, for what is described as extraordinary sound recreation.

Able to play over six hours of continuous music, the KMD-C80 is configured with a six disc magazine. An optional KCA-S200 CD/MD changer switch box is also available that permits connection of both a CD changer and MD changer and switching between the two.

The KMD-C80 has an RRP of $2499 and is covered by a 12 month warranty.

Boundary mike from Beyer

The new Beyerdynamic MPC 65 Acoustic Boundary Microphone measures only 86 x 61 x 31mm and is ideal for recording and sound reinforcement applications requiring high quality reproduction of speech, including telephone and video conferencing systems, boardrooms, courtrooms and churches.

Beyer claim the MPC 65 provides higher gain before feedback than typical boundary microphone designs. The semi-cardioid response makes it ideal for multiple microphone installations, while its integral low cut filter eliminates low frequency rumble and unwanted surface bound noise. The microphone requires 12-48V DC phantom power and may be used free standing or surface mounted via an integrated connector in its base. ❖

'Richer sound' clock radio

Bose Australia has released an innovative clock radio which is claimed to give sound quality normally only available from fully featured hi-fi systems. This improved sound quality is generated by a 68cm twisting tube — the acoustic waveguide — which is folded inside the enclosure of the system. This technology has been developed by Bose founder Dr Amar Bose, who began perfecting it in the 1960s. In 1987, this patented folded acoustic waveguide technology earned Bose the prestigious Inventor of the Year Award.



The Wave Radio is built around two 50mm diameter speakers. The left hand speaker feeds the waveguide, which enables the system to generate bass frequencies down to 70Hz. Generally frequencies below 200Hz cannot be heard on any other system this size.

The Wave Radio features a digital clock radio, offering six AM and six FM radio presets, has mute, scan and automatic sleep features, as well as a battery back up in case of a power failure. It also features a wireless remote control which is the size of a credit card.

SONY'S SBM-1 ENHANCED A/D CONVERTER



This month our reviewer Louis Challis had the opportunity to evaluate the Sony 'Super Bit Mapping' technique, which gives enhanced noise performance for analog to digital conversion. Specifically, he was able to test the tiny SBM-1 stereo A/D Converter, in conjunction with Sony's very impressive and equally tiny TCD-D7 DAT Recorder.

Over the last two years I have noticed with increasing interest the number of Sony Classical CDs which are emblazoned with the words 'Super Bit Mapping' (abbreviated to SBM). Although I was vaguely aware that SBM was something new, I wasn't fully aware as to what the words 'Super Bit Mapping' meant, or more pointedly how the SBM system actually worked.

When Garry Beauchamp, the Manager of New Business Development at Sony Australia offered me an SBM-1 High Density Linear A/D Converter (which incorporates SBM technology), together with a matching TCD-D7 Micro DAT Recorder, I willingly accepted, as I had previously reviewed the TCD-D7 (in October 1994), and had been impressed by what it could achieve.

A small and relatively light carton duly arrived, the bulk of whose volume was taken up with soft polystyrene foam packaging. At the bottom of the carton were two small items of equipment. The TCD-D7 was small, but the SBM-1 was even smaller...

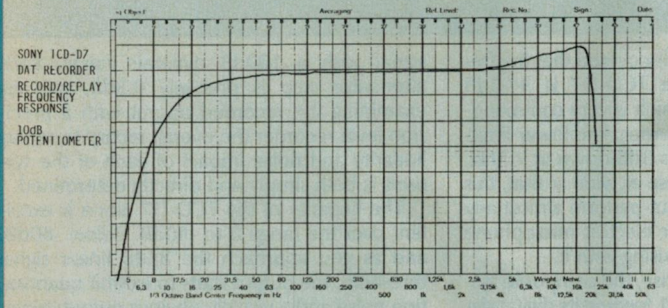
I examined each of the units in turn, and then the carton in my endeavours to find technical literature which would explain to me how the equipment worked, and more pointedly, how I would test them. The instructions for the TCD-D7 were immediately evident, but the instructions for the SBM-1 were nowhere to be seen.

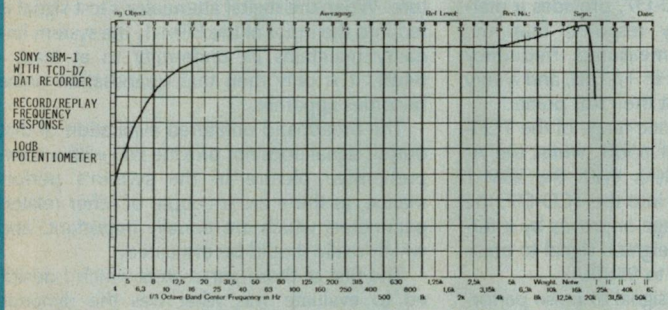
Two weeks later, following flurries of faxes and numerous telephone calls between Sony Australia Sydney's office and Tokyo, I received brief instructions on the SBM-1. Some days later, following repeated requests I also received technical information on the Super Bit Mapping technology.

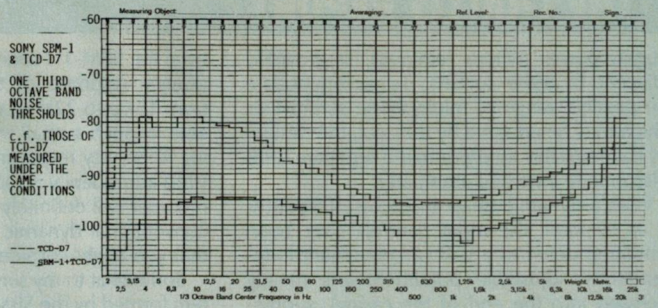
The SBM concept

The Super Bit Mapping system was developed to minimise the audibility of quantisation noise in a digital system, by adopting a series of complex digital data processing procedures, which make liberal use of psycho-acoustics. A fundamental basis on which the system works is to re-shape the internal noise threshold of the digital data, and to literally move the inherent noise energy from one portion of the spectrum where it would theoretically be audible, to another region where it normally isn't.

In so doing, Sony engineers have developed some of the most complex circuitry which I would ever have imagined, and have integrated it into a number of small chips with a flow





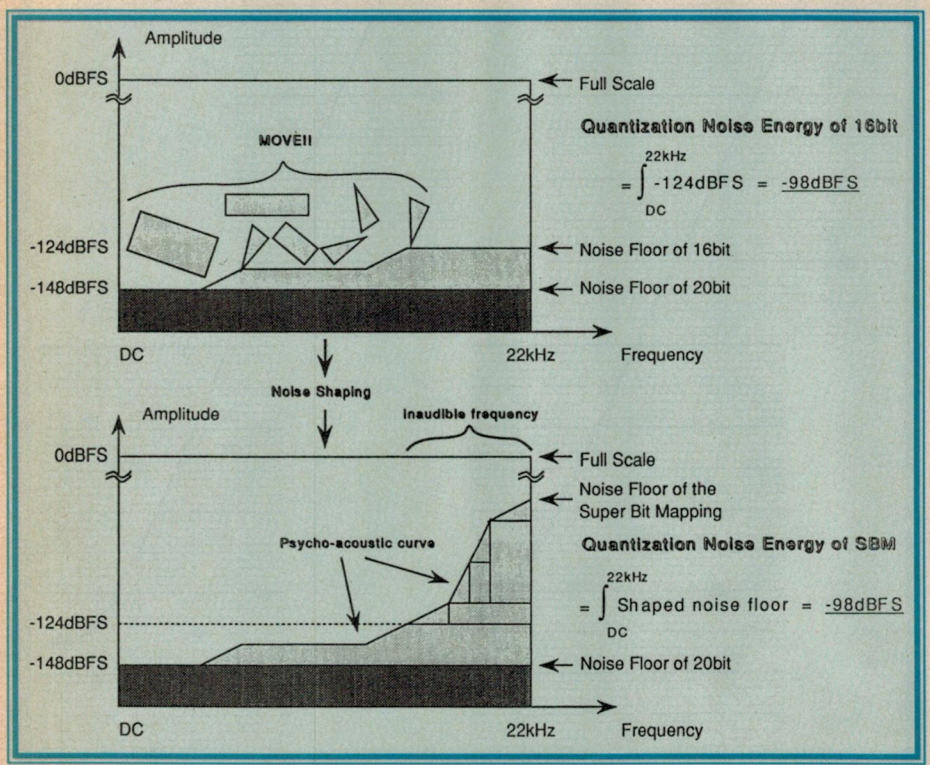


At top left is the record/replay response of the TCD-D7 DAT recorder alone, while at lower left is the response when combined with the SBM-1 'Super Bit Map' A/D converter. As you can see, it's marginally wider. At top right are the one third octave band noise thresholds for the DAT recorder alone and the combination, showing the improvement achieved.

chart which is mind-boggling in its complexity. Whilst I could present you with the 30-odd pages of text on the technical details of Super Bit Mapping, I fear that could only confuse you more, and leave you more perplexed than when you started reading this review.

After examining all the literature, it provided me with what I regarded as being an extremely complex review of the underlying principles of the system. Examining the hardware I soon formed the view that I needed to learn how to use the system and its multiple controls in order to be able to put it through its paces. Without doing that, I would not be able to evaluate the attributes or liabilities of the composite SBM-1 and TCD-D7 system.

The TCD-D7 is a relatively new miniature DAT recorder developed late in 1993, which has been marketed in Australia for over a year. I developed an immediate affinity for this DAT recorder as it is less than 1/8th of the volume, and is less than 1/6th the weight of my smallest DAT recorder. Its functional controls are sensibly laid out on the top of the opening lid, with additional controls on one side and at one end for the user's convenience.



Extracted from the Sony literature, this diagram is intended to show how Super Bit Mapping moves noise components in the lower part of the audio spectrum up to the high end where they can't be heard. We don't profess to fully understand how this is achieved...

As before I was immediately impressed by the clearly legible, and what appeared to be ergonomically sensible controls. But after I plugged in a set of long life manganese alkaline batteries, I realised that I couldn't find a power ON/OFF switch. (I hadn't noticed this last year.) None of my associates could find the power ON/OFF switch, either. Examining the handbook more carefully, there on page eight under 'Notes' I discovered the following cryptic comments:

* This unit is not equipped with a power switch. Consequently, as long as the batteries are inserted, the LCD display will always be turned on. However, the consumption of the electric current will be very small and negligible.

I breathed a sigh of relief, and continued with my assessment. I was impressed by the functional controls. When it came to connecting up microphones or line input sockets, I discovered that the Sony miniature tip-ring and sleeve microphone sockets are not identical to those produced by other Japanese manufacturers. This created considerable difficulty in achieving the proper connections, until I modified an existing Sony miniature tip-ring and sleeve lead...

I moved on to examine the SBM-1 High Density Linear A/D Converter. In this case the power ON/OFF switch was easy to find, and I noted that the SBM-1 provides three optional sampling frequencies of 48kHz, 44.1kHz and 32kHz.

Unlike the TCD-D7, the SBM-1 incorporates two large conventional gold plated 6.5mm diameter tip and sleeve microphone sockets. A miniature tip and sleeve socket for microphone

plug-in power (where required), is provided adjacent to those sockets. To accommodate the possible range of microphone sensitivities which may be adopted by the user, the designers have sensibly incorporated a separate 20dB microphone switched attenuator.

With a dynamic range in excess of 90dB(A) at its disposal, the input controls have been simplified down to a pair of convenient independently adjustable potentiometers (neatly recessed into the end of the casing), supplemented by two small LED displays. When the peak input signal exceeds the permissible limit, these illuminate, and provide adequate warning that the peak signal is within 5dB of the clipping limit. As I subsequently discovered, you must take great care to avoid that happening. The battery condition is displayed by four LEDs. The first of which indicates 'F' for full, with two intermediate levels displayed, and the last labelled 'E' for exhausted.

A pair of gold plated RCA coaxial line input sockets are also provided, with a switch to select either mic or line input levels. A miniature tip-ring and sleeve headphone socket is also provided, with its own independent volume control.

The digital signal output is furnished through a relatively thick flexible captive lead. This has a special miniature polarised shrouded plug with seven pins at its outer end. The lead connects the digital signal directly into a matching socket at the lower rear corner of the TCD-D7 DAT recorder.

Lab testing

On my initial appraisal, I formed the view that there were only a limited number of critical parameters which warranted a detailed evaluation. Those parameters were:

- The frequency response of the TCD-D7 DAT recorder when fed with a signal into the normal inputs.
- The dynamic range of the TCD-D7 DAT recorder, and the shape of the noise threshold of the TCD-D7.
- The frequency response of the combination of SBM-1 and TCD-D7 DAT recorder.
- The extent to which the dynamic range of the combination of SBM-1 and TCD-D7 is enhanced when the two units are used in combination.
- Last but not least, the shape of the noise threshold of the SBM-1 and TCD-D7 DAT recorder when used together.

In order to draw the correct conclusions when conducting such an evaluation, there are a number of associated parameters which also need to be considered. Those parameters include the extent of dynamic headroom of the TCD-D7 and similarly that for the SBM-1.

I proceeded to evaluate those parameters in a number of different ways, which used both conventional measurement equipment, and some non-conventional equipment. The time required to carry out those evaluations proved to be far greater than I would have guessed, but that is the way it generally goes these days.

My first series of laboratory tests examined the record to replay frequency response of the TCD-D7 and the TCD-D7 fed with digital input from the SBM-1. I soon discovered that the frequency response of the TCD-D7 is +/-1dB from 15Hz to 22kHz, which is very commendable for such a small recorder. The lower limiting frequency response is 3dB down at 7.5Hz. With a frequency response as wide as that, this recorder will definitely out-perform almost any conventional dynamic or electret microphone that you might consider using with it.

Somewhat to my surprise, the composite system formed by the SBM-1 feeding its digital signal directly into the TCD-D7, provides a marginally wider frequency response than the TCD-D7 alone. The measured frequency response is 12Hz to 22kHz +/-1dB, and a very pleasing 6Hz to 22kHz at the -3dB points.

The unweighted dynamic range of the TCD-D7 alone is in excess of 85dB, whilst the A-weighted range is 91dB(A). With the SBM-1 feeding its digital output into the TCD-D7, the unweighted dynamic range improves by a further 7dB, whilst the A-weighted signal to noise ratio is further improved to 95dB(A).

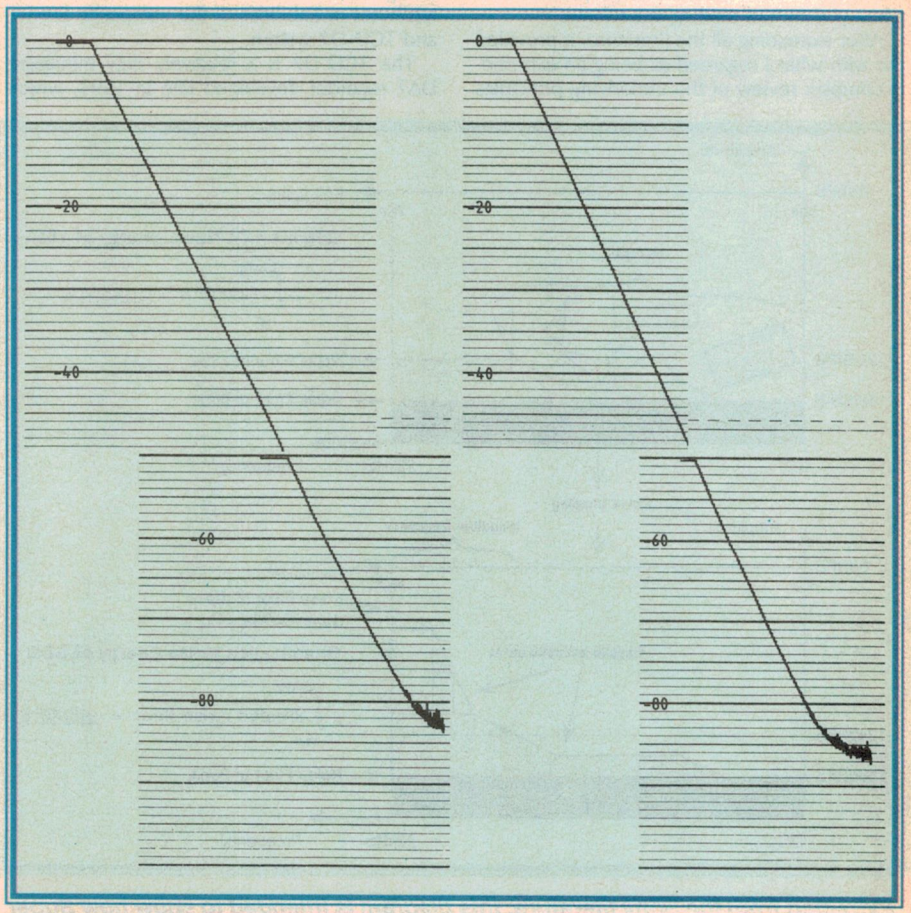
Having measured the signal to noise performance figures by the simplest method possible, I then adopted a more refined approach. The next approach evaluated the signal to noise ratio and the dynamic linearity by means of an automated digital attenuator. This provides an extremely linear and very accurate signal with a 100dB dynamic range. Each attenuator step is precisely 0.5dB, and by examining the recorded output with a precision level recorder the overall record to replay linearity and noise impact of each of the systems is both simply and directly determined.

The linearity of the TCD-D7 alone is excellent over the range 0 to -80dB. Below -80dB, and as you approach the 85dB linear signal threshold, the output starts to exhibit quantisation noise and a visually obvious output curvature. When the digital attenuator's test signal is fed into the input of the SBM-1, the system linearity maintains its uniformity to at least -84dB. It is only then that quantisation noise becomes apparent.

The broadband unfiltered evaluation of that output signal does not provide you with a comprehensive picture of the system's performance, as there are a couple of other related parameters which are equally important, and which really should be evaluated.

The first of those parameters which I decided to evaluate was what was the dynamic headroom of the SBM-1, when relying on the LED overload indicators to set the input level. That investigation was further expanded to determine what degree of compression occurs when those overload lights are illuminated...

By incrementing the input signal in 1dB steps



At left is the dynamic linearity plot for the TCD-D7 recorder alone, while at right is the linearity when it's combined with the SBM-1 unit. As you can see, Super Bit Mapping extends the linearity by four or five decibels.

over and above the initial overload threshold, I discovered that there is at least 1dB of useable signal margin before the onset of any significant degree of signal compression. The next four 1dB increments of increasing signal are progressively compressed into a minuscule +1dB change in output level.

Explained in another way, if the level of the input signal is increased by +5dB, the incremental change in the output signal is compressed to a total change of only +2dB. However any further increase in the level of the input signal then proves to be beyond the limits of the SBM-1 linear A/D converter, which behaves in a most nonlinear manner, as it reverts to an overload mode and switches off its output.

On that basis, the system signal to noise ratio figures can be quoted as being 1dB higher than I measured, but no more.

At that point I decided that it was time to evaluate the frequency response characteristics of the system when operating close to the noise threshold. I evaluated those parameters for both the TCD-D7 alone, and for the combination of SBM-1 with the TCD-D7. The approach adopted was to generate a very low level pink noise signal, whose absolute level was attenuated by 90dB below that required to produce a maximum recording level (with no overload). The spectrum of pink noise used was within +0.5dB of an optimally flat pink noise spectrum.

Measurements were taken of the one third octave band spectral output of the TCD-D7 with shorted input, and then repeated for the combination of SBM-1 and TCD-D7. I was delighted to observe that the SBM-1 circuit not only provided a significant measurable improvement in the noise threshold of the recorder, but more significantly, the shape of the spectrum changes according to the procedure described by Sony's technical literature.

As you may see from the attached sketch, that literature describes how the SBM-1 system recontours the noise threshold to conform to psychoacoustic principles, which enhance the perceived audible signal to noise ratio of the system.

Live recording?

I then decided it was time to evaluate the SBM-1 and the TCD-D7 with live musicians and musical instruments, in an environment which I believed would be perfect for the task. As it happens, on that very morning I had received an invitation to a 'Soiree Musicale' (charity evening) which was to be held at the Power House Museum. There wasn't enough time to pre-arrange what I hoped to do, but I was hopeful that if I explained my intentions to the Museum's curators, that they would graciously agree.

I packed up a set of 12mm diameter laboratory microphones, preamplifiers, miniature battery operated power supplies, and the SBM-1 and TCD-D7 into their neat over-shoulder carrying bag. I explained my purpose to the curators who appeared to be most cooperative, but who warned me that they would have to gain the musician's approval. I then sat down in a wonderful seat in the second row, and awaited what I hoped would be a partial approval.

Halfway through the first of the performances I felt a gentle tap on my shoulder, and a sweet young lady whispered into my ear "They don't approve!". My jaw must have dropped, as I realised that all my preparations had been for nought...

The Soiree was superb. In fact so good, that I almost forgot why I was sitting there, and that my magazine deadline was only a few days away.

Two days later, I set up the system and I recorded a single musician playing a piano in my home, but although that provided what some may regard as a reasonable test, it fell short of my aspirations and expectations.

Conclusions

The SBM-1 High Density Linear A/D Converter system is disarmingly unassuming in its appearance. Although its packaging is extremely small and it incorporates very few controls, it embodies outstanding and unusually effective psychoacoustic principles — which as I confirmed, really do work.

Some people may view the SBM-1 as being an expensive and unwarranted toy. That view could only possibly be sustained by people who have no interest in achieving portable recording perfection.

The detractors will cite the use of alternative conventional digital tape recorders used in their thousands in studios all over the world. Those studio recorders normally achieve equally impressive performances. When however, a recording engineer from one of those studios has to venture into the field, all too often he is hampered and embarrassingly hamstrung by equipment which is so big and so bulky, making the task disturbingly complex.

The SBM-1 and the TCD-D7 are intended to alter the balance of those horrendous forces so that the recording engineer can proceed into the field with an almost 'cavalier' attitude, knowing full well that there is only one additional issue to be surmounted. That issue may well prove to be a problem, in that the quality of the microphones will determine the quality of the signal that is recorded. Unless those microphones offer a comparable dynamic range, supplemented by a comparable frequency response, all that trouble and effort will be for nought.

As I have discovered, the quality of recording microphones is always of critical importance. If you are thinking of buying an SBM-1 and TCD-D7, then you really have to be prepared to allocate an expenditure of twice that much money (and conceivably as much as four times the funds) on your microphones and preamplifiers. If you don't allocate that order of resources, then the SBM-1 may not necessarily offer you any measurable improvement in the system's performance.

The dimensions of the SBM-1 A/D Converter are 136 x 89 x 29.4mm (L x W x D), and it has a weight of 280 grams. The TCD-D7 DAT Recorder measures 132.6 x 88.2 x 36.7mm, and has a weight of 500g. The quoted RRP for the SBM-1 is $999, while that for the TCD-D7 is $1399.

Further information on both of these products is available from Sony Australia at 33-39 Talavera Road, North Ryde NSW 2113; phone (02) 878 9712. ❖

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READER INFO NO. 2

The PianoDisc

If you love the sound of a piano, but find that acoustic recordings don't satisfy you, perhaps you need a PianoDisc system fitted to your own piano. It's relatively cheap, lets you record yourself at the keyboard, and is quite an incredible system, as you'll read...

by PETER PHILLIPS

Pianos that 'play by themselves' have been around for over 100 years, and it seems the interest in these instruments just refuses to go away. While most player-type pianos are of the vacuum-powered variety, there have been three notable developments over the last 20 years that have confirmed the future of the electrically powered player piano.

These three developments are inextricably linked, as I'll now explain: During the late 1970s, a company called Superscope marketed an add-on system that could be fitted to any piano to make it play from a specially adapted cassette player. It included a primitive type of record-yourself-at-the-keyboard system, and despite its relatively poor performance, it sold well, particularly in the USA.

Possibly because of the success of the Superscope system, and also to increase the public's interest in acoustic pianos, Yamaha decided in the mid 1980s to join the player piano market with the now well-established Disklavier. I reviewed this system in *EA* October 1988 when the first Disklavier piano reached Australia, and included a full history of vacuum-powered player pianos, including the Welte, Duo Art and Ampico reproducing pianos.

To clear the marketplace for the Disklavier, Yamaha purchased and shut down the operations of the Superscope system, by then owned by the Marantz Corporation. Caught without a product to sell, the Burgett Piano Company, a California-based distributor of the Superscope system, asked Yamaha for the rights to distribute the Disklavier.

Yamaha refused, and the future looked bleak for the once thriving distributor. But it seems nothing motivates people more than the desire to 'show the bastards', and the Burgett brothers, owners of the now defunct Superscope dealership, decided to compete head on with the giant Yamaha Corporation. Quite simply, they went ahead and developed their own system, called the PianoDisc. This all started in the late 1980s, and today the PianoDisc is thriving and even outselling the Disklavier.



The CD adaptor interfaces a CD player or VCR to a PianoDisc system. The adaptor separates the MIDI sound track from the conventional audio tracks from specially recorded CDs/tapes, and redirects them to a sound system and piano.

So what is the PianoDisc and what does it offer?

The PianoDisc

The PianoDisc is an electro-mechanical system that can be fitted to virtually any piano (upright or grand). Once fitted, the piano will play from pre-recorded 3.5" floppy disks via a disk drive fitted into a small control box. It will also play from a computer or, if you buy the CD adaptor, from specially recorded CDs or videos.

Like the Disklavier, the system is MIDI compatible, so any device that can output a MIDI file will play the PianoDisc. If you also get the record option fitted, MIDI recordings can be made from the keyboard. With this option, a piezo strip-type sensor is fitted under each key to produce an output voltage related to the force applied to the key. This voltage is converted to a MIDI velocity level and recorded with the note information. As a result, the recording has all the information to give an accurate reproduction of the original performance.

The fact that the PianoDisc can be retrofitted to virtually any piano is perhaps its major selling feature, as the Disklavier is only available as a factory-fitted extra to a new Yamaha piano.

How it works

The basic PianoDisc installation consists of a bank of 88 solenoids, arranged to push the underside of the back of each key of the keyboard. In a grand piano, this means a slot has to be cut in the keybed. The power applied to each solenoid is determined by the MIDI velocity level for that note, and is controlled electronically. The usual way to control the striking force of such a solenoid is with *pulses* of current, rather than simply varying the value of the current.

During the development of the PianoDisc, great care had to be taken not to infringe the patents taken out by Yamaha. As a result, the PianoDisc uses a system called 'pulse mapping', compared to the Disklavier's PWM (pulse width modulation) system.

The circuitry in both instruments includes dedicated ICs and microcontrollers, and neither company has given details of their system, so it's really a guess as to *exactly* how each system works.

The foot pedals of the piano also need to be actuated to recreate a performance, and it's here the PianoDisc and Disklavier systems differ considerably. The Disklavier has a complex solenoid arrangement to operate the sustain and the soft pedal. As well as on-off control, the Disklavier has position control for each pedal, which allows all aspects of pedal operation to be recorded and recreated.

On the other hand, PianoDisc uses a very basic on-off pedal actuating solenoid, and then only on the sustain pedal. That is, there's no soft pedal actuator, an omission I believe is being presently addressed. As well, to avoid overheating it, the electronics automatically turns off the sustain pedal solenoid after 15 seconds. I'll have more to say later about the pedal limitations of the PianoDisc.

The recording system of both systems is also markedly different. The Disklavier has a bank of optical sensors fitted to the top of the piano action, with the beams interrupted by small vanes attached to each hammer shank. The PianoDisc, as already mentioned, uses a specially developed touch-sensitive strip fitted under each key.

The Yamaha system is claimed to introduce virtually no extra weight to the 'touch' of the piano and to give a very accurate translation of hammer velocity to a MIDI level. The PianoDisc system adds a few grams to the weight of each key, making the piano action 'feel' slightly heavier. Again I'll have more to say about this aspect later.

The control box

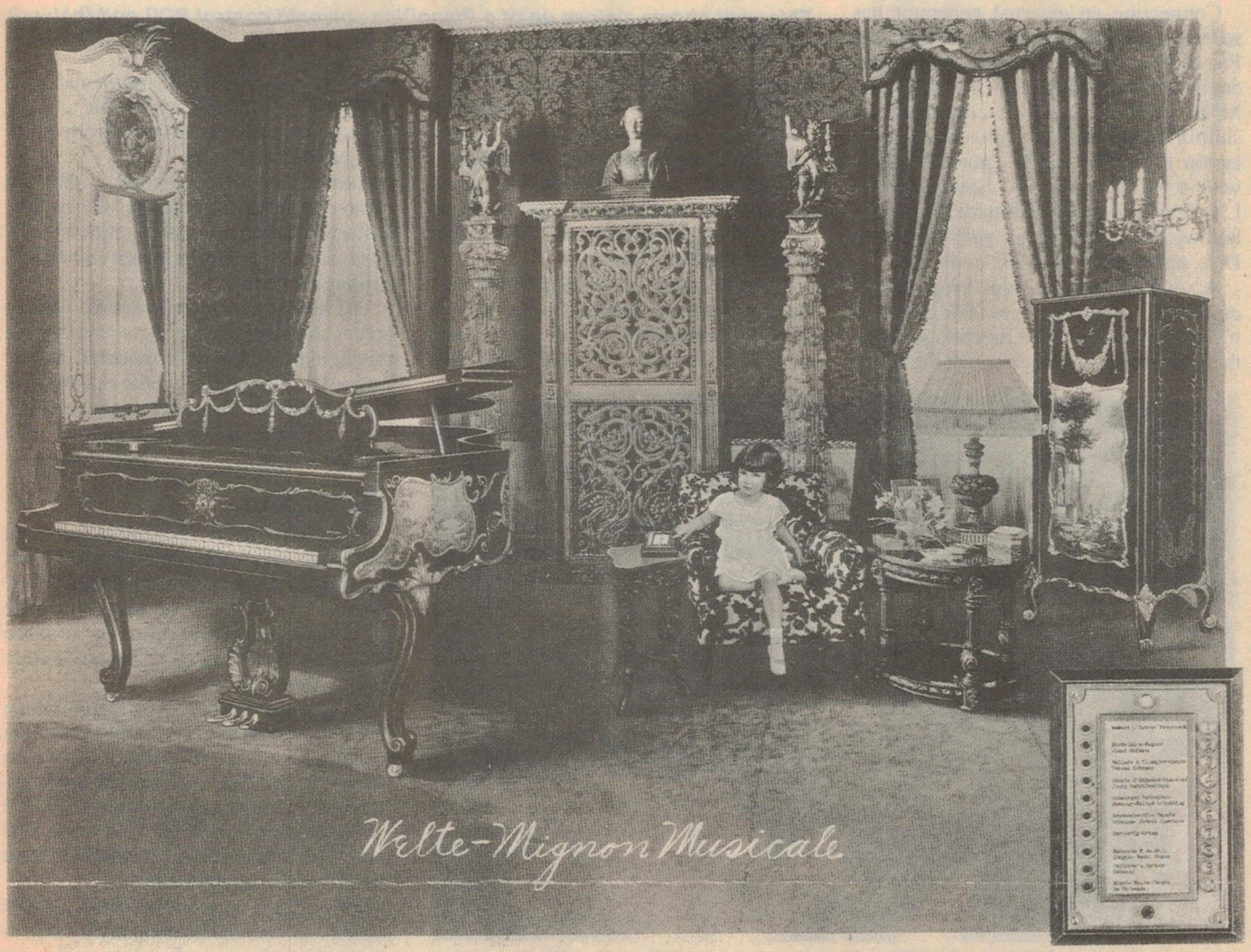
The control box for the PianoDisc is very small (230 x 230 x 50mm) and is less than half the size of the Yamaha control box. Both units have similar functions, are remote controlled, and derive their power from the installation in the piano. Interestingly, both systems will only work with 720KB 3.5" disks.

The control box can be attached to the piano or placed as a free standing unit many metres away. Functions include a volume control, transpose and tempo controls, and a range of disk operations (formatting, erasing a song and so on).

The rear of the box is fitted with a range of connectors that include MIDI in, MIDI out and MIDI thru 5-pin DIN connectors, and a 6-pin DIN connector for power and data transfer between the electronics in the piano and the control box.

Extras

A basic no-frills installation includes the control box and the solenoid bank to play the notes. Incidentally, the system can only be fitted by specially trained installers, as there's far more to it than

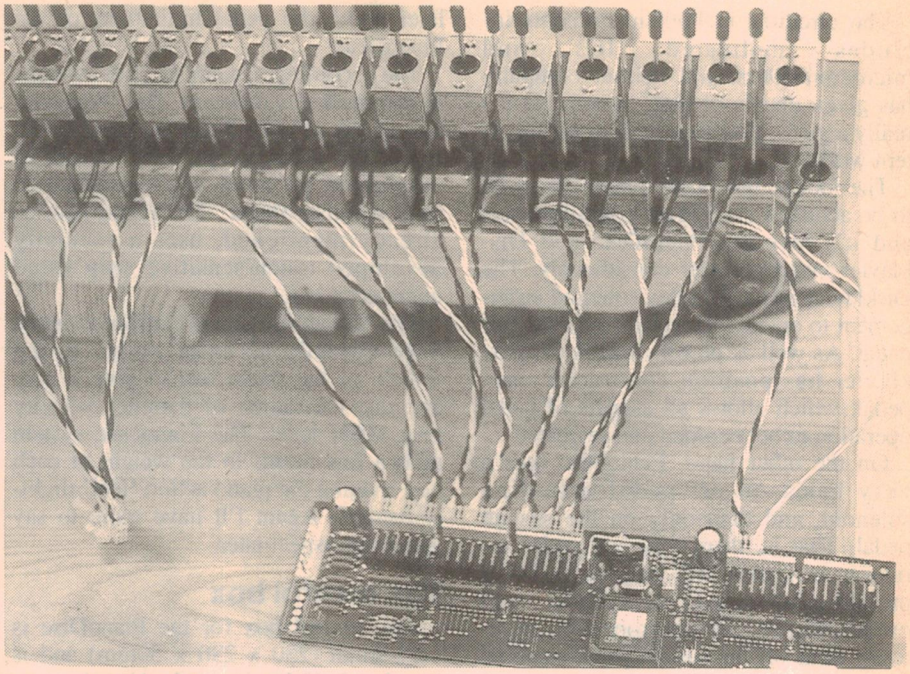


This promotional photo from 1925 shows a Welte Mignon reproducing piano. The cabinet on the right contains a piano roll changing mechanism, and rolls are selected by pressing a button on the handheld selector.

simply mounting the solenoids and connecting everything together.

The most popular extra is the record facility, which adds about $1000 to the cost. This feature allows a pianist to record a performance to disk, either in the control box or via MIDI to a computer. It also means the piano becomes a totally compatible MIDI keyboard.

Another popular extra is a MIDI sound generator. PianoDisc supply a sound generator card that fits inside the control box, but any MIDI sound generator can be connected to the system via the MIDI connector labelled SYNTH OUT, on the rear of the control box. The front panel of the control box shows the selected voice of the PianoDisc card or of an external sound generator, providing the external generator is General MIDI compatible.



This shot shows a close up of a PianoDisc solenoid control PCB and (behind) the note driving solenoids.

Sound generator

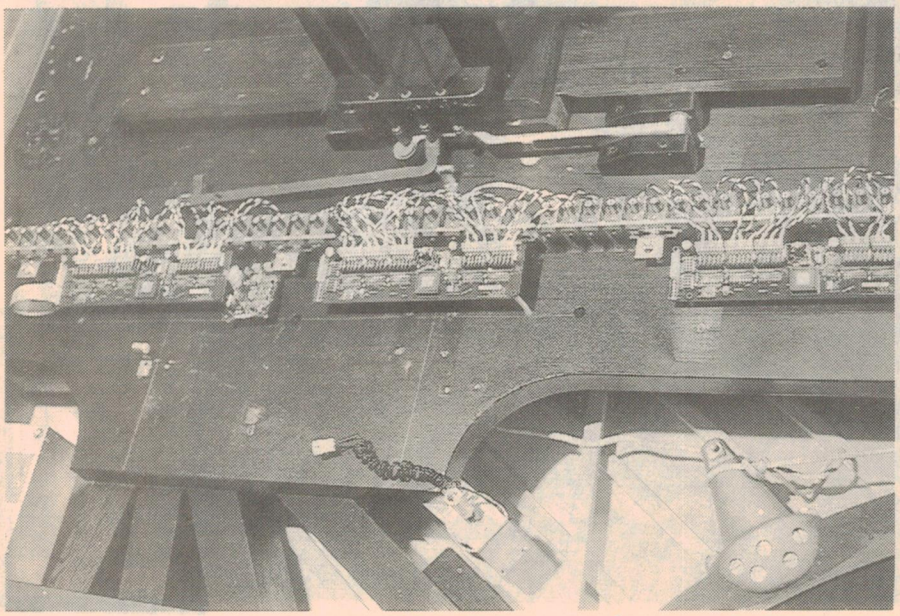
Connecting an external generator has several advantages compared to using the PianoDisc card. For example, if the generator is fitted with an RS-232 connector, MIDI connections to a computer are simplified (essential if you are using a laptop computer which cannot be fitted with a MIDI card). The Kawai GMega LX (reviewed in *EA* February '95) is one box we know works well with the PianoDisc, and it has an RS-232 connector.

A sound generator gives a number of quite marvellous facilities. For instance, if the PianoDisc record function is fitted, the piano can then play through the sound generator while it's being played as a conventional piano. This gives additional sounds like a church organ, strings or any voice from the bank. And, depending on the selected voice, the additional sound appears to be independent from the piano sound, giving an arrangement-like quality to a keyboard performance.

A more conventional use is with PianoDisc or Disklavier recordings that include multi-part arrangements of pieces from the popular repertoire, including big band numbers and popular instrumentals. As well, any multi-part MIDI file can be played through the system, from a sequencer or a computer.

Another useful advantage is that the piano can be played 'silently'. To do this, a mechanical arrangement is fitted to the piano so the hammers are prevented from striking the strings.

The sound generator is set to a piano voice, and the pianist hears everything through headphones connected to the generator. The effect is quite uncanny, as the pianist can play with great satisfaction and realism without anyone else hearing a thing.



This photo shows a complete PianoDisc playback installation, with the covers removed. The sustain pedal solenoid is at the bottom centre of the photo (lever not installed), while the power supply (partly obscured) is on the left.

CD adaptor

The most recent development from PianoDisc is a control box that receives its signals from pre-recorded CDs or videos. This unit can be used alongside the conventional control box, or in place of it. However it doesn't have any floppy disk facilities.

Perhaps the most exciting feature of the CD/video system is integrating analog sounds and video with MIDI. This means for a CD you hear all the real (not synthesised) instruments, other than the piano, through a conventional sound system. The piano sound is supplied from the PianoDisc equipped piano.

For a video, you see the pianist on the screen and hear the accompanying instruments through a sound system, with your piano providing the piano performance. The effect is almost mind boggling, as

suddenly everything is so much more real, almost like a live performance.

Plans include recording jazz performances, classical pieces (piano concertos, trios etc) on both video and CD. It's also planned to add a MIDI piano track to various Marx Brothers films, so Chico's incredible piano antics are played via a real piano. To date, there is no equivalent to the PianoDisc CD adaptor for the Disklavier.

Performance

Before I give my opinion on the performance of the PianoDisc system, I should give my credentials. I've been involved with pianos almost all my life, I play the piano and I regularly attend live concerts that feature the piano.

With regard to mechanical pianos, I claim to be one of the first people in the world to have interfaced a vacuum-powered reproducing piano (Ampico) to a computer.

I was also the technical person behind the pushup-style piano player that recreated Percy Grainger's playing of the Grieg Piano Concerto, in a series of orchestral concerts in the late 1970s and early '80s. I described how this was done in *EA* October 1978. This work was done in conjunction with one of the world's most famous collectors of reproducing piano rolls, Denis Condon, whom I visit regularly.

In fact, I was motivated to buy a PianoDisc system after Denis purchased a Disklavier. I was convinced the PianoDisc could match the excellent quality of the Disklavier, and I decided to have the system fitted to my 20-year-old Yamaha G5 grand. The piano was in excellent playing condition due to recent work on its action, and the PianoDisc was a cheaper option than a new Disklavier.

It's important to realise that the performance of any mechanical piano playing system is totally dependent on the quality of the piano. A tight or unregulated action will convert an otherwise sensitive performance to a disaster. I mention this in case you might have heard and been put off by a badly regulated player.

In my opinion, the PianoDisc system is excellent. It delivers a huge dynamic range, subtle soft playing and excellent repetition. It's easy to use, and the installation is neat and unobtrusive.

Recordings of hand-played performances are accurate, and the extra weighting caused by the strip sensors under the keys is negligible. In fact, I can't even tell the difference.

There are a range of adjustments available through the control box, although PianoDisc prefers these to be left alone. An important adjustment is the soft playing, which I found could be optimised by carefully setting the minimum level for each note.

The instrument will play from Disklavier recordings, although the differences in the pedal information means some recordings have to be edited to get the best performance.



The PianoDisc control box is remote controlled and has a 720KB 3.5" disk drive. It connects to the piano installation via a six wire cable.

PianoDisc recordings will not play on a Disklavier (perhaps this is intentional!) and the disks cannot be read by an IBM computer, despite the claim by PianoDisc that the disk formatting information is PC-DOS based. However, it's very easy to link a computer to the PianoDisc control box so MIDI files can be created and edited with MIDI software.

Bad points

My main criticism of the PianoDisc is the pedal system, particularly the lack of a soft pedal actuator.

Virtually all professional, and especially concert pianists use the soft pedal, as this is how subtle soft playing is created. The fact that the sustain pedal solenoid has a maximum on-time of 15 seconds has already proved to be a limitation for me. However, I'm told these issues are being addressed, and I hope fixed.

There are other minor irregularities, like keys on the remote control unit that don't do anything, and a few operational aspects that I think could be improved. But these are all minor points and don't spoil the enjoyment of the system.

Summary

While the PianoDisc system is enjoying huge popularity in the US, it's likely few readers will have heard of it here in Australia.

However, because the system will promote interest in acoustic pianos and therefore boost their sales, I think we can look forward to seeing and hearing a lot more of the PianoDisc in the near future.

The library of recordings is growing daily, and is currently centred on popular music. Pianists include Peter Nero, Floyd Cramer, Steinway artists and many others. The system is also being used in the US by Steinway and Bosendorfer to promote their pianos.

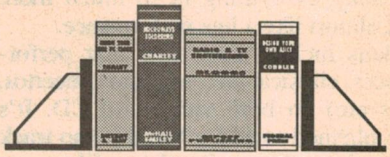
The electronics in the PianoDisc looks simple enough, thanks to the use of LSI ICs, and repair is done by board replacement. The system is guaranteed for five years.

In conclusion, I can thoroughly recommend the PianoDisc for piano students, teachers and for anyone who enjoys hearing a *real* piano. There's nothing like the 'real thing', and even a basic upright piano can produce a greater sense of immediacy and excitement compared to a recording.

Approximate prices (including installation) are $7000 for a basic system, $8000 for playback and record, $8300 for playback and Symphony (sound generator card), everything $9400, with $1200 for the CD player adaptor. New pianos (from small uprights to large grands) fitted with the PianoDisc are also available. Prerecorded disks range from $32 to $52.

For further information contact Richard Andreoni, PianoDisc Australia (02) 953 7644. ❖

NEW BOOKS



Reference manual

THE BENCHTOP ELECTRONICS REFERENCE MANUAL, Third Edition, by Victor F.C. Veley. Published by Tab Books (McGraw-Hill), 1994. Hard covers, 243 x 193mm, 730 pages. ISBN 0-07-067376-4. RRP $115.00.

The latest and expanded edition of this comprehensive reference book, which is designed primarily for the working technician and engineer, but also likely to be of considerable value to the student or experienced hobbyist. Author Dr Veley is an emeritus professor and former Dean of Science and High Technology at Los Angeles Trade-Technical College, and is currently a part-time instructor in its electronics department.

It covers a very wide range of topics, from Kirchoff's laws, matrices and other basic maths through to fairly advanced matters like quartz crystal oscillators, transmission line losses, the Smith Chart and its use, radar receiver bandwidth and so on. There are even a few topics related to thermionic valves or 'tubes', for those who need to design around them. In all, there are a total of 240 topic 'chapters', with nine data appendices and an 'answers to practice problems' appendix at the rear.

The information on each topic, while fairly concise, is also quite friendly and accessible. In most cases there's also an accompanying mathematical derivation of any formulae required for design work, raising the book to a level beyond the usual kind of 'a circuit and a few paragraphs per topic' reference. In fact many of the topic chapters are surprisingly thorough and complete, for this type of 'global electronic reference' book.

In short, then, a very well produced book, and one which should be of considerable value to almost anyone working in electronics.

The review copy came from McGraw-Hill Australia, of 4 Barcoo Street, Roseville 2069. (J.R.)

Digital cookbook

MODERN TTL CIRCUITS MANUAL, by R.M. Marston. Published by Butterworth-Heinemann, 1994. Soft covers, 138 x 215mm, 219 pages. ISBN 0-7506-2092-7. RRP $42.95.

The cookbook style of presentation began with Don Lancaster's *TTL Cookbook* of 1974, and has since become popular in electronics books as a way of mixing theory and practical circuits. The author of this new book is likely to be known to many readers from his other 'Circuits Manual' books, all of which follow the cookbook style, but with an emphasis on background theory.

The book contains seven chapters, and starts off by explaining digital IC basics, going on to describe TTL principles and introducing the various sub-families within the '74 series, along with the basic rules for using TTL. It then deals with logic circuitry, and includes the symbology and mathematics of digital logic, basic data on digital ICs and a range of practical digital gate circuits.

The later chapters progress through waveform generator circuits, clocked flip-flop and counter circuits, special counter/dividers, data latches, registers, comparators and code converters. The final chapter deals with the more specialised digital ICs such as multiplexers, demultiplexers, addressable latches, decoders, full adders, bus transceivers, priority encoders and rate multipliers.

Most of the ICs described in the book are from the 'LS' TTL family, but some 74HC CMOS devices are included.

The book is aimed mainly at those involved in the practical design of digital circuits, but because of its theory content, will also be useful for students of digital electronics. It has a friendly, no-nonsense writing style and includes a large number of simple practical circuits.

The review copy came from Butterworth-Heinemann, PO Box 5577, West Chatswood 2057. (P.P.)

TV update

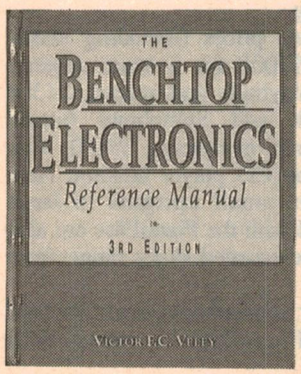
SATELLITE AND CABLE TV, by B.M. Ponnappa. BPB Publications, 1994. Soft covers, 235 x 177mm, 294 pages. ISBN 81-7029-408-8. RRP $19.95.

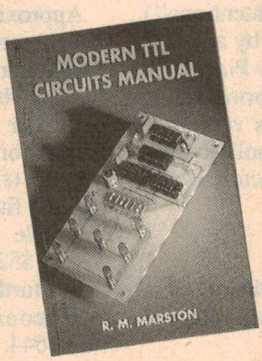
Written in Bangalore and published in New Delhi, this book seems to have been intended at least initially for the domestic market in India — which has been quite active for some years, in terms of both cable and satellite TV. However it's a fairly comprehensive general introduction to this subject, and one that should be of interest and value to many people in other countries like Australia and New Zealand.

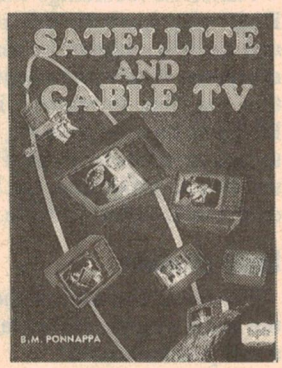
It starts off with the basics of radio wave propagation, progresses through transmission line and antenna theory, transmission and reception principles and TV basics. Then it covers satellite and cable systems, both from the theoretical and practical sides.

The English text is a little rough in places, with a fair number of typos, and some of the diagrams are a bit crude. There are also relatively few photos, and these are so poorly printed that they're virtually two-tone rather than greyscale. But there's a lot of useful and informative information there, and of course the book is quite inexpensive — so on the whole, it's still well worth considering as an introduction to this topical subject.

The review copy came from Jaycar Electronics, which stocks it in its stores as Cat. No. BM-2490. (J.R.) ❖







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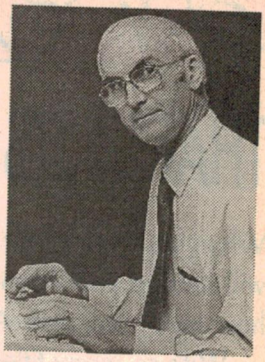
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MAG/CHR/000 '95

FORUM

Conducted by Jim Rowe



DIY projects and the PSTN: interesting responses from Austel

It's very unusual for us to be able to follow up on a Forum topic in the very next issue, due to the inevitable delays involved in producing a monthly magazine. But this month we can effectively do so, because I've received a couple of interesting responses from Austel explaining the official position with regard to DIY projects like that 'Off-Hook Alarm' we discussed last month...

Of course there's no way one can *really* get around the production delays involved in a monthly magazine; to paraphrase Scotty's famous saying from *Star Trek*, "You canna change the laws of printing, Jim". In reality I'm having to prepare this November edition of Forum while the October issue of the magazine is still at the printers, and won't be published for another two weeks or so. So clearly the material I'm about to present *can't* be a response to last month's Forum — but that's because in reality it's a response to something that happened much earlier.

You may recall from last month's column that back in late 1992, following the revision of the Telecommunications Act, I had sent a letter to Austel asking if there remained any possible way in which we'd ever again be able to describe DIY projects involving devices or equipment for connection to the public switched telephone network or 'PSTN'. Up until the time of writing last month's column I'd never received a reply to that letter, and as a result I'd had to assume that 'no news was bad news'.

However what I didn't explain last month was that a week or so before writing that column, I'd phoned and faxed Austel once again — trying to get a belated response to the 1992 letter, and perhaps also a comment regarding our ill fated Off-Hook Alarm project.

Well, nothing happened in time for the October column, but shortly *after* we'd sent the October issue off to the printers, I did get a response from Austel — first by phone, and then a couple of days later by fax and follow-up letter — plus some further phone conversations.

The response came from Mr Rex Christensen, General Manager of Austel's Technical Regulation division, and I should point out that since Mr Christensen is basically responding to my original 1992 enquiry, he makes no specific comment here in this first response regarding our Off-Hook Alarm project. However during our subsequent phone conversions this project *was* discussed, and Mr Christensen invited me to send down basic details of the project so that his department could offer some specific suggestions. More about this shortly, but for the moment let's look at Austel's long-awaited general response:

CONNECTION OF KITSET CONSTRUCTED EQUIPMENT TO A TELECOMMUNICATIONS NETWORK OPERATED BY A CARRIER

This is a very belated letter to your 20 November 1992 letter, and your (very patient) prompting facsimile dated 18 July 1995. I apologise for the matter "falling through the cracks". Anyway, I hope this letter constructively addresses the issue, i.e. are there legal means of connecting owner/builder assembled equipment to a carrier's network? In response to your enquiry, we have devised two alternative methods.

As background, Attachment A is an outline of the regulatory requirements for the connection of customer equipment to a carrier's network, so that you may readily appreciate the constraints on using other than the usual permit process.

The two legitimate connection methods are as follows:

Kit Set Construction — Permit Issue

This approach consists of an Australian based kit set supplier:

- *obtaining a permit for an equipment built from its kit set, using the normal permit application process. The supplier would give kit set owners/constructors advice on the use of that permit, and include a permit label in the kit set;*
- *Documenting and maintaining the design and construction of the subject equipment in a construction file that uniquely defines the construction of that equipment;*
- *Supplying a full kit set of parts, construction, adjustment and setting to work details etc, to facilitate the construction of an equipment of the same type as that permitted. (A definition of 'equipment of the same type' is given in Attachment A.)*
- *Not making any design or componentry changes, including componentry specification changes, in that kit set, except as authorised by an approved permit variation.*

Note that if an intending kit set supplier uses the design services of a person with detailed knowledge of the requirements of AUSTEL's Technical Standards (as would be prudent to produce a compliant equipment in a cost effective manner), that latter person may be eligible to be appointed as an AUSTEL Approvals Liaison Engineer; such appointment would entitle him/her to change the design of the equipment within defined bounds, without reference to AUSTEL as each instance occurs — see the copy of AUSTEL's Technical Approvals Guide No 4 'Approvals Liaison Engineer' at Attachment B.

Inherent in this connection approach are the following:

- *The owner/builder has the responsibility for achieving an equipment of the same type as that permitted in order to achieve a legally connectable item of customer equipment;*
- *The permit holder is free to supply completely assembled equipment of*



the same type under that permit subject, of course, to it continuing to be equipment of the same type;

- *A condition of the permit would be that if the kit set supplier changes the kit set contents with the effect being that it no longer facilitates the construction of an equipment of the same type, then the permit will no longer apply, and either a new permit application or a variation of the permit would be required.*

Note that kit set suppliers could minimise the costs of compliance testing by accredited laboratories by using the following 'approved' component parts, as relevant to the design:

- *Plug packs approved by a State electrical regulator;*
- *an appropriate line transformer from AUSTEL's Certified Component List, for the interface component to the connected telecommunication network line, to provide adequate overvoltage hazard safety isolation to or from that line.*

Specified Classes of Equipment — No Permit Necessary

This approach could be adopted for the (indirect) connection of specified classes of equipment to a carrier's network through an intermediate permitted customer equipment, e.g. a permitted modem, or a permitted alarm dialler, subject to certain conditions being met. The equipment covered by the specified classes could be kit set constructed, constructed by means other than using a kit set, or purchased as a completely assembled equipment.

The classes of equipment are those covered by relevant AUSTEL section 267 exemptions under the Telecommunications Act 1991, of which there are two:

- *Data Terminal Equipment, dated 20 Jan 1993, and*
- *Security Alarm and Fire Alarm Equipment, dated 9 Feb 1993.*

A copy of these Notices, together with Explanatory Memoranda, is at Attachments C and D.

The conditions to be met are specified in these Notices. They include, for both Notices, the requirement that the intermediate permitted customer equipment has a Safety Extra Low Voltage interface connected to the exempted equipment (so that overvoltage hazards on a carrier's network are not passed on to the specified classes of equipment, and vice versa).

Equipment falling within the definition of the classes of equipment covered by the Notices include:

- *Personal Computers, microprocessor controllers;*
- *Digital input/output telemetry equipment;*
- *Alarm activators and sirens used solely for providing (a) a security alarm service, or (b) a fire alarm service (but only where powered by a SELV power supply (e.g. plug pack) approved by a State of Territory electricity authority).*

We would be pleased to answer enquiries as to whether other equipment falls within the above specified classes of equipment.

In conclusion, I trust that you find the above specified approaches useful. Please do not hesitate to contact me if you wish to further explore the subject.

As you can see, Mr Christensen's letter shows that Austel has 'gone out of its way' to come up with possible strategies via which construction projects could qualify as 'permitted' equipment in order to be legally connected to the PSTN. It's a very interesting response, and probably about as helpful as Austel could be — bearing in mind the rather

tight constraints imposed on them by the Telecommunications Act. I'm very grateful to Mr Christensen and his team for their careful consideration.

By the way I haven't attempted to reproduce here the various attachments mentioned in the letter. We don't have the room to do this, and in any case there's probably no need to go into things here to that depth. I think the main gist of Mr Christensen's explanation is pretty clear from his letter itself.

You'll note, though, that of the two approaches listed, only the first really applies to projects like modems and diallers which need to connect directly to the PSTN. The other approach really only covers things like computers and other equipment which connects only indirectly — for example through a modem. In other words, equipment for which I imagine most of *EA*'s readers wouldn't have expected to even *need* a permit from Austel, at least until they read last month's discussion of the Telecommunications Act...

Austel seems prepared...

Confining ourselves to the first approach, then, Austel certainly seems able and prepared to allow equipment built from a kit to be granted 'permit' status and used legally on the PSTN, provided that the kit supplier was prepared to meet the requirements listed. As you can see, this would include having a prototype unit tested and given a permit; ensuring that kit buyers/builders were given all information necessary to ensure that they duplicated the prototype in all relevant respects; maintaining full documentation for the equipment's design and construction; and not varying the components used in the kit.

I'm not sure how many kit suppliers would actually be prepared to go through this process, even though as Mr Christensen points out the costs could be minimised by ensuring that 'approved' components were used for key components like the plug-pack power supply and the line coupling transformer. I gather that if this were done, the remaining tests and permission process might typically only cost a few hundred dollars. More about this shortly.

Of course it's still a pretty involved process compared with that required for 'normal' electronic kits, and the additional hassle may not be judged worthwhile. I imagine that at least some kit suppliers would simply not bother producing kits for these projects at all...

In any case, this exact approach doesn't seem to directly involve magazines like *EA*. Nor does it offer a great deal of hope to those individual constructors who prefer to build their equipment themselves rather than from a commercial kit.

Possible variation

From a follow-up phone conversation with Mr Christensen, I gather that a possible variation on the approach described would be for Austel to allow magazines like EA to get a permit for our original prototype of a design, and then provide all necessary information in our published article to allow constructors to ensure that their unit was identical with the permitted prototype in all relevant respects. Needless to say, we'd also have to warn constructors in the article that their unit could ONLY be used legally on the PSTN if it were built in exactly the manner described, and using the exact components specified.

Following this approach, it's even conceivable that we could publish a small 'Permitted Attachment' label in the article, for constructors to attach to their own unit. But naturally the responsibility for ensuring that their unit was in fact 'legal' would rest with the constructor themselves. If it was not constructed exactly as described, and using the specified components, it would still be illegal; in this case if it were connected to the PSTN the constructor would still be liable for that horrendous $12,000 fine.

While it's reassuring to hear that this modified approach might be feasible, I have to confess that I'm still not sure how practical it would be. For magazines like *EA*, which are quite tiny compared with the sort of organisations that normally have to cope with the business of getting equipment tested for a Permit, it would still be quite a rigmarole.

Not only that, but considering *EA*'s own modest editorial budget the additional costs involved would be quite significant, and not easy for us to justify. After all, magazines like *EA* don't actually make any money directly from published project designs; any money that's made from them is made by the kit suppliers, rather than ourselves. We only benefit indirectly, from (hopefully) continuing support by readers and advertisers.

It would therefore be hard for me to justify to the magazine's proprietors spending hundreds of additional dollars getting a project design tested for a Permit, when the only people who make any *real* money from our designs are the kit suppliers — and when the additional costs involved would be very significant as a proportion of the total project development costs. I suspect my masters would view this additional cost as 'wasted', and would probably direct me to publish projects that didn't involve these additional costs, instead...

(Incidentally, you may be interested to know that although many of the firms who develop telecomm products would be able to claim an 'R&D' tax rebate for the full cost of this testing and Austel Permit process, magazines like *EA* can't do this because we can't make an R&D claim. Since we don't end up selling a specific product based on our development work, the ATO doesn't regard it as legitimate R&D.)

Our Off-Hook Alarm

As you can see, Austel is certainly trying to be helpful in the general sense with regard to magazine DIY projects and their legal use in connection with the PSTN, even though the approach they're able to offer is still not a particularly attractive one in some respects. But what about our poor little Off-Hook Alarm project, which first prompted us to look into the Telecommunications Act and its far-reaching ramifications?

Well, as mentioned earlier I brought this up during the discussions with the Austel people. And Mr Christensen, who seemed keen to demonstrate that Austel is more than just a stern enforcer of that draconian Act, very kindly invited me to send down brief details of the project — circuit, photos and so on — so his team could give it a quick and informal 'in principle' evaluation. Needless to say I was eager to take advantage of this invitation, in case they could come up with a possible way for us to rescue the project.

Not long afterwards, I had a call from Mr Christensen and Dr Vembanoor Mani, who is Austel's Manager of Engineering Approvals. They gave me a fairly encouraging verbal appraisal of the Off-Hook Alarm project, commenting that although it didn't seem to meet a couple of their requirements as it stood, there was a possibility that we could modify the design to make it capable of passing the applicable tests, without a great deal of difficultly.

At my request they agreed to send us a letter summarising the position with regard to the project, and in due course this letter arrived over the signature of Dr Mani:

I refer to your letter and attachments of 17 August 1995.

The circuit has been analysed to the extent possible, as there was no information made available to us concerning how it operates. Here are my comments.

- ***TS001 which calls up AS/NZS3260 for safety.***

Because the Off Hook Alarm (OHA) is internally powered and does not have any connection to other classes of circuits (i.e., it is all a TNV circuit), compliance with TS001 and AS/NZS3260 can be acquitted by ensuring the user has no access to the TNV circuitry. Testing to AS/NZS3260 clause 6.4 would be sufficient to demonstrate compliance with safety requirements (AUSTEL staff cannot assess this requirement).

- ***TS002 for connection to the PSTN***

The significant clauses applicable for the OHA are:

1. Clause 5.3 Insulation resistance: The circuit, as supplied, would not comply with this clause. The customer equipment is in the off-hook state all the time.

2. Clause 5.4.3 Series equipment: The OHA complies.

3. Clause 5.4.4 Bridging equipment: The OHA would comply with this requirement.

4. Clause 5.6.1 Fail safe operation: The OHA should comply.

5. Clause 5.6.2 Line polarity: The OHA complies.

6. Clause 5.6.5, which calls up AS/NZS3548 for EMI: The equipment should comply with this requirement — please refer to Advice To Industry 94/02 (copy enclosed).

7. Clause 5.6.6 Line connection: The OHA would comply if all connectors and cords were from the CCL.

The circuit, as it is, does not comply with TS002 clause 5.3. As discussed I am sending an extract of the requirement from TS002.

Testing against AS/NZS 3260 must only be done in an AUSTEL accredited test house, and a report must be made available to AUSTEL with your application for a permit. I am enclosing a copy of Technical Approvals Guide No. 3 Customer Equipment permits: Guide for Applicants for your use.

Please feel free to contact me if you wish to discuss this further.

As you can see, Dr Mani is again striving to be as helpful as possible, while inevitably having to remain within the constraints imposed upon Austel as the enforcer of the Telecommunications Act. At the same time, I think you'll agree that for those of us who

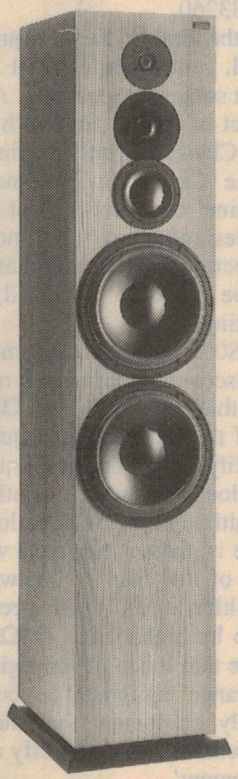
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don't need to cope with the Act's many ramifications every day, his letter is rather cryptic and hard to follow.

For example I don't know about you, but that term 'TNV' threw *me* initially. I searched through all of the attachments that came with the second letter, and nowhere could I seem to find any explanation of that term. Finally, in a follow-up phone conversation, I learned that it means 'Telecomm Network Voltage' — a term which apparently encompasses all of the voltages found on the PSTN, including the 50V DC from the exchange, the AC ringing voltage, any test voltages sent down the line from time to time, and spikes from nearby lightning strikes, etc.

Let me try a little further translation. Those 'TS001' and 'TS002' references are to Austel's Technical Standards No. 001 and 002. In turn TS001 seems to 'call up' or rely upon Australian Standard AS3260 and its New Zealand equivalent NZS3260, which are electrical safety standards for information technology equipment. Similarly in clause 5.6.5 of TS002, another Australian/NZ Standard is called up: AS/NZ3548, which apparently covers electromagnetic interference and compatibility.

Also the 'CCL' referred to in Dr Mani's letter stands for 'Certified Component List', which was mentioned in Mr Christensen's letter — a list of components like plug packs and line isolation transformers, which Austel has approved for use in telecomm equipment. (These telecommunications people *love* acronyms, don't they? Even our little Off-Hook Alarm project has become an 'OHA'...)

Basically, from my reading of one of the attachments that came with the first letter, TS001 seems to be designed primarily to ensure the safety of anyone using equipment connected to the PSTN, while TS002 is designed to ensure that the equipment is technically compatible with the network itself and all other equipment connected to it.

Now if I understand Dr Mani's letter, it seems to indicate that we'd need to do two things with our little OHA, to make it qualify for an Austel Permit. One is that we'd need to modify its circuitry so that it would meet that Clause 5.3 in TS002, for Insulation Resistance; the other is that it would need to be tested for user safety isolation, as per Clause 6.4 of AS/NZS3260.

Looking at the first of these requirements in detail, I must confess that initially I found it somewhat puzzling. As I read the extract of TS002 sent with Dr Mani's letter, Clause 5.3 only seems to apply when the 'Consumer Equipment' is in the 'off line' condition — yet our OHA, being designed purely for monitoring and detecting, is by its very nature intended to be 'on line' in 'bridged mode' all the time...

Although TS002 doesn't really make it clear, I've discovered that what it really means is that although our OHA meets ONE of the line loading requirements to qualify as a 'bridged equipment', it doesn't meet another. Specifically, although its AC line loading impedance is greater than 5kΩ with a phase angle of less than 10° between 300Hz and 3.4kHz, its DC loading resistance needs to be higher than 1MΩ, in order to ensure that it can never register with the exchange equipment as being 'on line'. Only equipment that meets *both* requirements is able to qualify as a 'bridged equipment'.

In other words, we would have to redesign our OHA so that it has a much higher DC input impedance (i.e., greater than 1MΩ).

The other reference, to TS001 and AS/NZS3260, is rather more clear cut and is pretty clearly intended to ensure that the user of a device like the OHA is protected against injury or shock from spikes and other high voltage that may be present on the PSTN line — from nearby lightning strikes, etc.

From the extract of AS3260 sent by Dr Mani with his letter, it appears that Clause 6.4 involves a test of the isolation and voltage breakdown capability provided by the consumer equipment's case. Essentially for our OHA the test would seem to involve wrapping the case with conductive foil, and applying either of two specified alternative test voltages between the foil and the PSTN line connections. The test voltages are either (a) ten pulses of 2.5kV, alternating in polarity and 60 seconds apart; or (b) 1.5kV AC (50 or 60Hz), or alternatively 2.12kV DC, slowly increasing to these values and then again applied for 60 seconds.

It seems likely that our OHA *wouldn't* pass such a test as it stands, but it might do so if we were to move the piezo speaker inside the case, and also substituted a pushbutton and LED with improved isolation. In any case, as Dr Mani stresses in his letter, we'd need to have it tested by one of the 'Accredited Test Houses'.

From what I've been able to find out, having this kind of test performed on a prototype of the OHA by one of the test houses concerned would probably cost us about $200. As Austel itself charges a further $200 for the Permit Application Fee, this means that we'd be up for an additional $400 or so — quite apart from the cost of redesigning the project before we could even get it tested.

Frankly, this would represent a very significant additional investment in the project, from the magazine's point of view. It would make the little Off-Hook Alarm quite an expensive project, and I couldn't really justify the expenditure.

All told, then, it looks as if we'll have to forget the Off-Hook Alarm after all.

To be honest, I suspect much the same situation is going to apply with any other DIY project intended for connection to the PSTN. From a practical and economic point of view, it really isn't going to be feasible for magazines like *EA* to describe such projects any more.

I'm very grateful to Austel's Rex Christensen and Dr Vem Mani for taking the trouble to consider the situation carefully, and coming up with their encouraging suggestions. But one way and another, it does seem that Australia's wonderful Telecommunications Act — together with the bureaucratic machinery required to ensure its observance — has effectively killed off at least one kind of DIY electronics project: virtually anything that hooks up directly to the PSTN.

A little sad, isn't it? ❖

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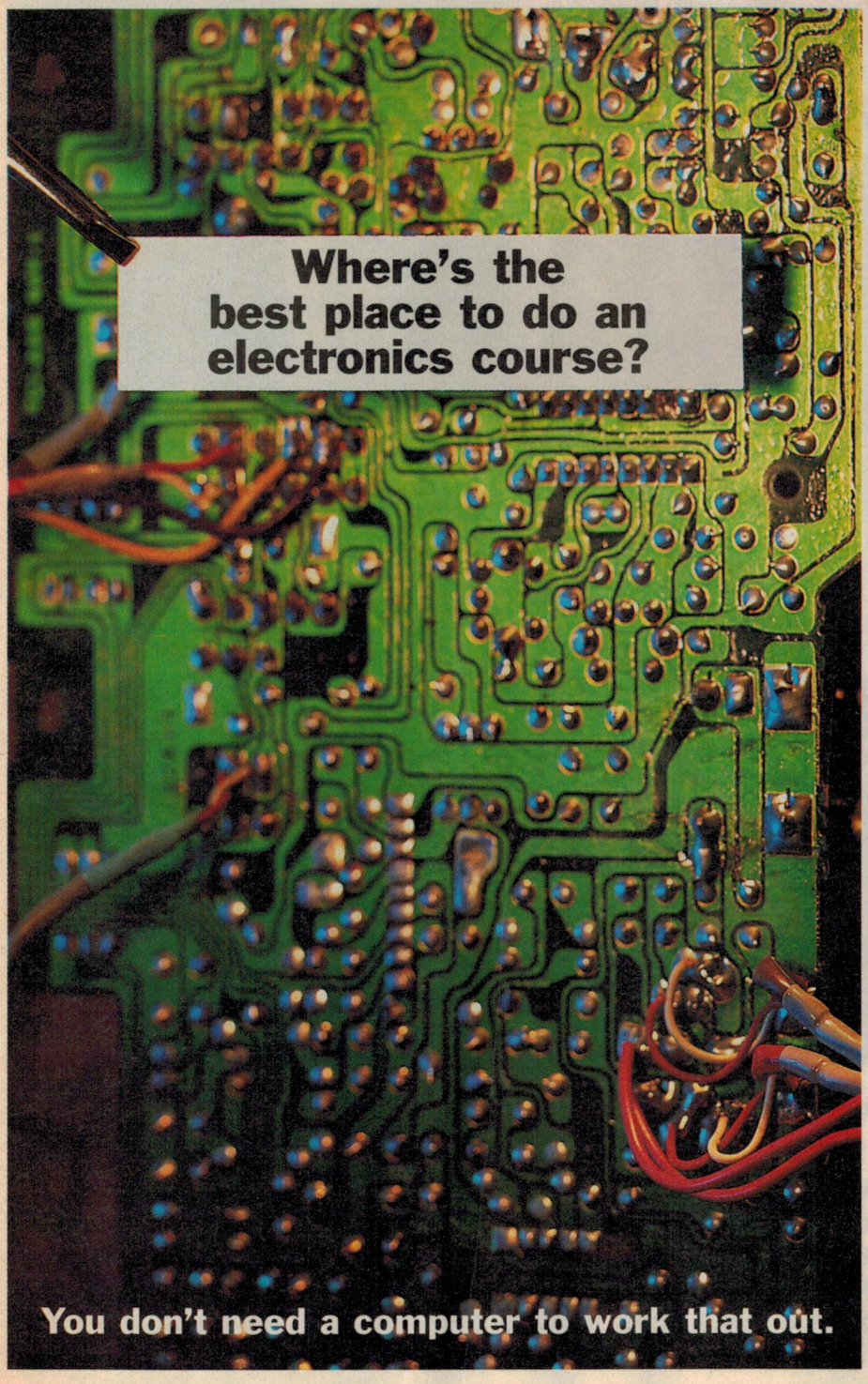
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OBSERVING THE VIOLENT UNIVERSE



The Chilean coastline and the arid Atacama Desert dominate this view from the ASTRO 2.

Earlier this year, NASA's successful STS 67 mission saw space shuttle *Endeavour* orbit and return with the ASTRO 2 astronomy payload, consisting of a suite of high-tech telescopes to carry out measurements and observations in the ultraviolet area of the spectrum. As UV emissions are generally associated with the 'birth' and 'death' of celestial bodies, the information brought back by ASTRO 2 is expected to provide a major boost to our understanding of the origin and evolution of the universe...

by KATE DOOLAN

For thousands of years, whenever astronomers looked at the night sky, they had to use the naked eye because nothing else had been invented. In 1610, the Italian astronomer Galileo Galilei started to use a recently invented telescope to view the night skies — and almost overnight doubled the scientific world's knowledge of the night sky.

For almost the next 400 years, the telescope was further modified and developed until it was the astronomer's most valuable viewing instrument. With the advent of the Space Age in October 1957, ideas for space-based astronomy from Earth orbit were developed. Now there are a series of robot observatories and telescopes placed in Earth orbit that view the universe on a continuous 24 hour a day basis.

The best known of these is the Hubble Space Telescope, which has been revolutionising astronomy since it was launched in April 1990. Observing the planets has not been left out either, as all the planets except for Pluto have been visited by robot spacecraft of the United States or former Soviet Union. Pluto isn't going to be left out, and will be expecting a visitor by the beginning of the next decade.

Following the deployment of robot observatories and telescopes, it was only a matter

of time until professional astronomers made the trip into orbit. And this year that's exactly what occurred, with the flight of ASTRO 2 aboard the space shuttle *Endeavour* in March.

To take advantage of Comet Halley's visit to Earth during 1985 and 1986, each of the world's major powers decided to send robot spacecraft to encounter the Comet. The Soviet Union sent two Vega spacecraft, Japan sent the Sakigake and Susei spacecraft and the European Space Agency sent Giotto. But where was the United States?

Due to the increasing militarisation of the US space program, there was not enough money for the National Aeronautics and Space Administration (NASA) to build and launch a robot spacecraft to meet Halley. Instead, NASA decided to cram a space shuttle payload bay full of astronomical instruments, call it ASTRO 1 and launch it in March 1986, when the Comet was making its closest approach to Earth.

These ambitious plans came to an end on 28 January 1986, when the space shuttle *Challenger* exploded soon after launch. STS 61E, carrying the ASTRO 1 payload which was to be the next shuttle launched, was cancelled — leaving ASTRO 1 in the lurch.

The United States also suffered some embarrassment when it was the only major space power not to send a spacecraft to observe Halley's Comet. The next opportunity for close up observation of the Comet will be in 2061...

Once the space shuttle successfully returned to flight in September 1988, NASA scheduled the ASTRO 1 mission to take place in early 1990. Originally scheduled to launch on 16 May 1990, ASTRO 1 showed an amazing reluctance to leave the launch pad — the launch was cancelled five different times from May to December, due to a series of equipment difficulties and hydrogen leaks in the space shuttle *Columbia*. Finally launched on 2 December 1990, ASTRO 1's problems did not stop with its arrival in Earth orbit.

The mission was plagued with breakdowns of the support equipment, and the STS 35 crew spent a great deal of their time manually operating the equipment after the automatic control for the three telescopes onboard malfunctioned and manual control also failed. A series of fixes radioed up from Mission Control enabled the astronauts to regain control of the telescopes, and the results that they bought back (although not as numerous as planned) were very impressive and hopes were high for a reflight of the ASTRO 1 experiments.

NASA originally had no plans to refly the ASTRO experiments, but a flight was scheduled for 1995 — some said after the intervention of Senator Barbara Mikulski of Maryland. Senator Mikulski represents the state where two of the ASTRO experiments originated, and more importantly is on a Senate appropriations committee that oversees and supervises NASA's budget.

UV telescopes

ASTRO 2 is the second of a series of missions designed to explore the universe in ways not possible from the Earth's surface. ASTRO uses unique ultraviolet (UV) telescopes to observe and measure UV radiation from celestial objects in relatively small fields of view.

Astronomical objects that were selected for observation by ASTRO 2 included planets, moons, stars, star clusters, nebulae, quasars, supernovae, galaxies and clusters of galaxies. The information collected by ASTRO 2 was planned to supplement data collected by ASTRO 1 and other sources.

When the universe is viewed in wavelengths beyond the visible spectral region, it takes on a remarkably different appearance depending on the temperatures of the objects being observed. Ultraviolet and X-ray radiation carries information about the structure and nature of intensely hot objects. Such sources in astronomy represent some of the most dynamic phases and events in stellar and galactic evolution, often occurring at the beginning or end of an object's lifespan.

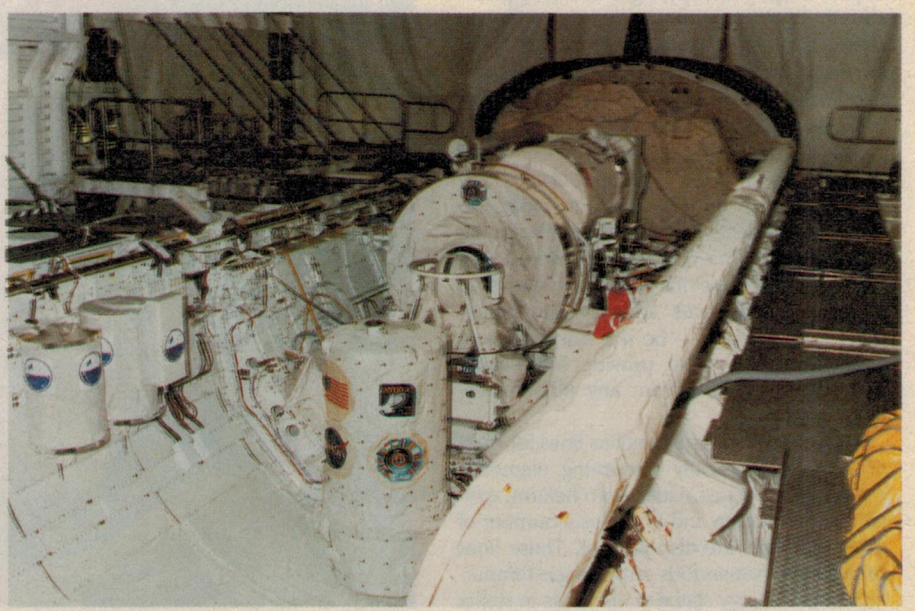
Such radiation cannot be viewed from Earth, since our atmosphere serves as an effective filter. Observations can only be made by brief sounding rocket flights, or from long term orbiting space observatories such as NASA's Extreme Ultraviolet Explorer.

The ultraviolet (UV) spectrum is the region between X-ray and visible light. In astronomical terms, the UV wavelength range is from 200 to 4000 angstroms. An angstrom is the customary wavelength measurement, and one angstrom is one ten-billionth of a metre (0.1 nanometres). By comparison, visible light spans the region from 4000 to 7000 angstroms (400 - 700nm). The ultraviolet region is further divided into the extreme ultraviolet — 200 to 400 angstroms, the far ultraviolet (1000 to 2000 angstroms) and the near ultraviolet (2000 to 4000 angstroms) bands. Ultraviolet radiation, like most of the electromagnetic spectrum, is largely unable to penetrate Earth's atmosphere.

Ultraviolet astronomy reveals intriguing parts of the universe that have only recently become observable. Accurate detection and interpretation of ultraviolet radiation requires observation from above Earth's absorbing atmosphere. Until very sensitive detectors, photographic film, high resolution imaging, spectral analysis techniques and spaceflight were developed, astronomers could only make wild guesses about the UV universe.

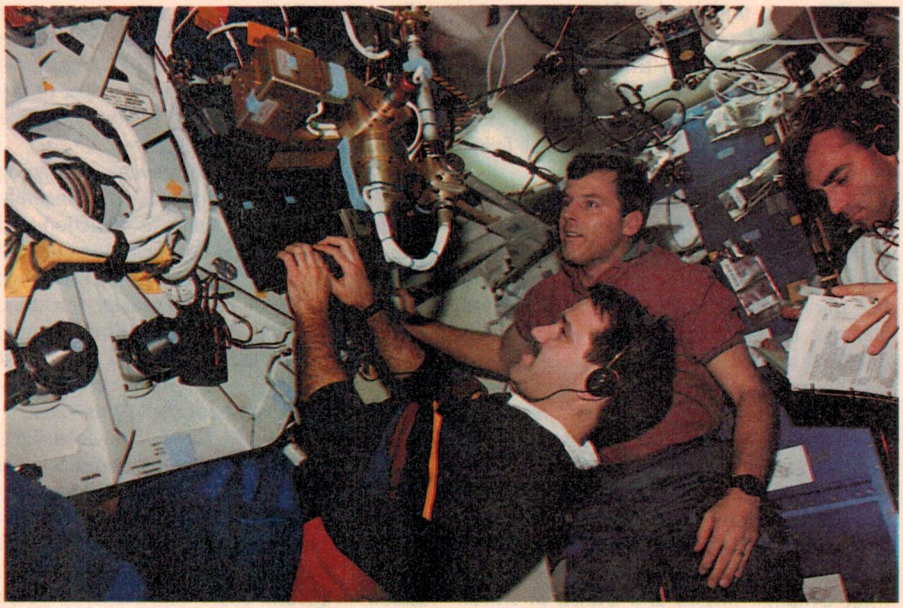
If we can view the sky in ultraviolet light, most stars would fade in prominence. We would be able to view some very young massive stars and some very old stars and galaxies, growing hotter and producing higher energy radiation nearing their birth or death. Clouds of gas and dust would block our vision in many directions along the Milky Way. Disregarding the much more numerous cooler visible objects, we would have a less cluttered view of the universe and see only the hotter parts of star clusters and galaxies.

The solar system, our galaxy and the universe are rich in UV radiation. In the past, ultraviolet satellites have dealt almost exclusively with the near- and far-ultraviolet emissions, because the technology of mirrors could only reach to about 1000 angstroms. In addition, radiation at wavelengths below 912 angstroms is absorbed by hydrogen, which is the most abundant element in the universe. This cutoff also compounds the problems of detection, and is called the Lyman limit.



The ASTRO 2 payload complement has been installed in the payload bay of the orbiter Endeavour, undergoing preflight processing in the Orbiter Processing Facility.

Observing the Violent Universe



Astronaut Stephen S. Oswald (centre) mission commander, is seen with two of his fellow crew members and an experiment which required a great deal of his time. Astronaut John Grunsfeld inputs mission data on a computer while listening to a cassette, and Astronaut William Gregory at right (pilot), consults a check list.

Many ultraviolet bright objects have already been identified. This radiation tells us something new about the origin, structure and evolution of many different kinds of celestial objects.

Ultraviolet observations of many types of astronomical objects are of great interest to astronomers because many hot stars and other energetic objects emit most of their light in the far ultraviolet range. By techniques of spectroscopy, light can be separated into its component wavelengths. Different chemical elements emit or absorb radiation at certain characteristic wavelengths or spectral lines. These lines are 'signatures' that uniquely identify the elements.

Spectra of many objects contain emission or absorption 'lines' throughout the UV range, caused by elements or ionisation stages of elements that are not visible in the optical range. The relative characteristics of these lines can be interpreted in terms of chemical abundances and physical conditions in the object — be it a star, galaxy or gaseous nebula — to provide information that is not available from any other wavelength range.

The ultraviolet band contains lines for most of the astrophysically interesting elements, especially hydrogen. Lines from helium, oxygen, neon, carbon and iron plus a number of other elements are also present. These lines represent a tremendous range of gas temperatures and energy states of elements in stellar atmospheres and in the interstellar medium.

Some photographs of the ultraviolet sky have been made. Photographs have the advantage of recording the relative brightness, location and structure of a large number of objects simultaneously. A number of objects were photographed during the ASTRO 1 flight, and ASTRO 2 continued the task of imaging the sky in ultraviolet light.

Ultraviolet radiation is more readily absorbed or scattered by gas and dust than visible light. Even though the density of interstellar gas and dust is extremely low, radiation travels large distances from the stars to us. Thus, scattering is a problem — especially for viewing objects in the plane of our Milky Way galaxy. This disadvantage can be turned to an advantage, however. If we look at the problem from another perspective, the material in interstellar space is so tenuous that it is difficult to study the composition of the dust or the size of the dust grains. Theoretical investigations have shown that the dust with different compositions or size distribution scatters and absorbs UV light in different ways. By observing distant stars whose light has been affected by interstellar dust scattering, scientists can learn something about the properties of the dust.

Light scattered by dust is often polarised. This has been detected optically, but was never studied in the ultraviolet until the flight of ASTRO 1. Light can be polarised by many situations, but polarised light seems to be more prevalent in regions where interstellar dust and magnetic fields are found together. Polarisation can be used to study both dust and magnetic fields that would otherwise be invisible to us.

Three experiments

ASTRO 2's payload consisted of three experiments and their associated support equipment. The three experiments were the Hopkins Ultraviolet Telescope (HUT), the Ultraviolet Imaging Telescope (UIT) and the Wisconsin Ultraviolet Photo-Polarimeter Experiment (WUPPE). These instruments were maintained and in one case upgraded since the first ASTRO mission.



Payload Commander Tamara Jernigan and payload specialist Samuel Durrance use the absence of gravity for a perusal of ASTRO 2 targets in a loose-leaf Rolodex type collection of data.

The ASTRO telescopes were mounted and coaligned on two Spacelab pallet platforms carried in the payload bay of the space shuttle. ('Coalignment' means that the instruments mounted on an instrument pointing system point in the same direction at the same time, which increases the scientific data return on every object observed.)

Unlike free flying satellites such as SPARTAN that are deployed and left in space, the ASTRO payload remained attached to the shuttle and was controlled by the astronauts onboard.

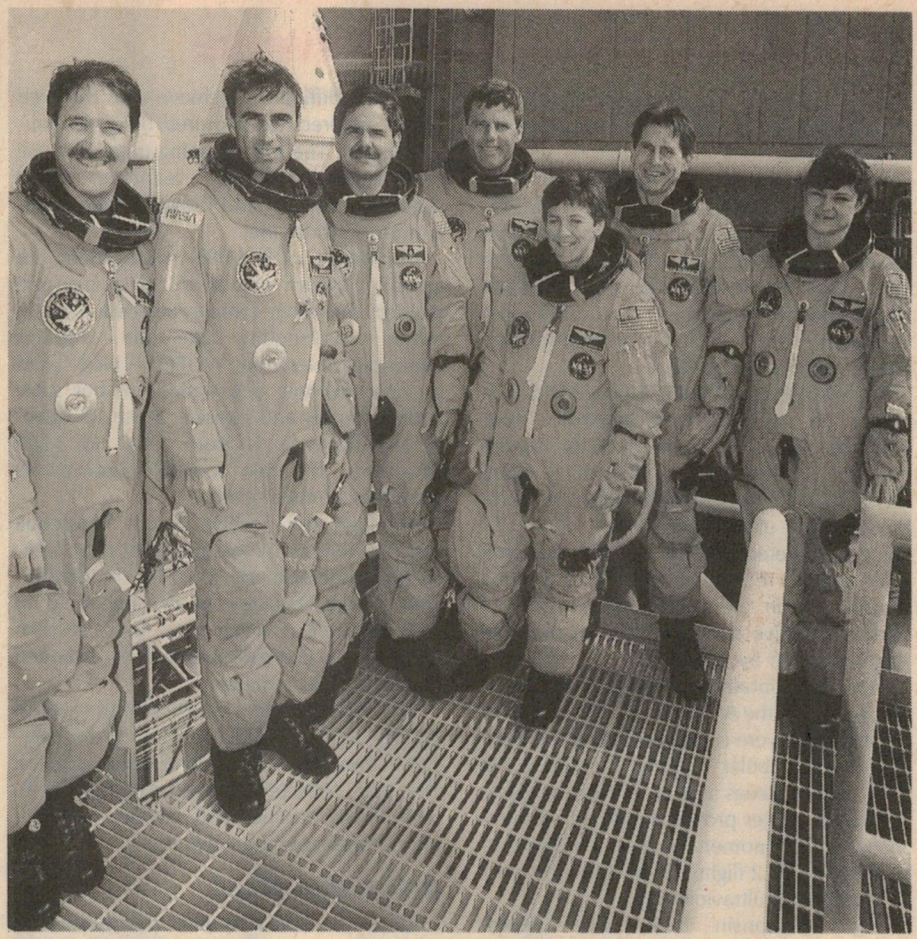
The ASTRO instruments worked together, simultaneously gathering ultraviolet imagery, spectroscopy and polarimetry on the same object. No other observatory or space payload can do this. ASTRO complemented and supplemented many other instruments for UV astronomy and also extended spectral coverage of objects studied at visual and X-ray wavelengths. Used in concert with the Hubble Space Telescope (HST), the International Ultraviolet Explorer (IUE) and the Extreme Ultraviolet Explorer (EUVE), ASTRO has extended the 'frontier' of astronomical observations into ultraviolet wavelengths.

For each Spacelab mission, specific standardised parts are combined to form a unique mission design. To scan the sky and locate interesting celestial objects, the ASTRO instruments needed a stable platform and precise pointing system. Two Spacelab pallets and the Instrument Pointing System were assembled for the observatory's configuration. The unpressurised pallets were anchored in the space shuttle's payload bay to form the base of the observatory. A pressurised cylindrical container named the 'igloo' was located at the head of the two pallets, and housed subsystems that provide such services as power, telemetry and commands to the instruments.

The Instrument Pointing System (IPS), which was developed and built by the European Space Agency as part of Spacelab, is a gimballed support structure that can be pointed in various directions. It is attached to the pallets, yet it isolates ASTRO as much as possible from the space shuttle's disturbances. This was the third flight for the IPS, which flew on Spacelab 2 in July 1985 and on ASTRO 1.

The three ultraviolet telescopes were mounted and precisely coaligned on a common structure called the cruciform, attached to the pointing system. The IPS can point the ASTRO instruments to view any target within approximately 30° of zenith to the payload bay.

An image motion compensator which was constructed by the Marshall Space Flight Centre in Huntsville, Alabama improved stability. Signals from a solid state star tracker and a gyro stabiliser are monitored by a small computer. Errors in pointing are quickly sensed, and corrected signals sent to a small secondary mirror in each telescope. The solid-state star tracker was developed specifically for ASTRO by the Jet Propulsion Laboratory located in Pasadena, California. Its sensor is a state of the art charged coupled device (CCD).



From left the STS-67 astronauts are: John Grunsfeld, William Gregory, Ronald Parise, Stephen Oswald, Wendy Lawrence, Samuel Durrance and Tamara Jernigan.

The Hopkins Ultraviolet Telescope (HUT) was designed and built by the Centre for Astrophysical Sciences at the Johns Hopkins University in Baltimore, Maryland with assistance from the Applied Physics Laboratory. HUT weighs 789 kilograms, is 3.7 metres long and 1.1 metres in diameter. HUT consists of a 90cm f/2 silicon carbide-coated parabolic mirror that focuses incoming UV light from a celestial source on the aperture of a prime focus spectrograph.

Covering the 825 to 1850 angstrom region with a three angstrom resolution, HUT opened the astrophysically important 912 to 1200 angstrom window to detailed scrutiny for the first time. Originally designed to explore the far and extreme ultraviolet ranges, HUT has been modified to concentrate on the far ultraviolet.

Since the ASTRO 1 flight, new coatings have been developed that are more reflective in the far-ultraviolet range. The primary mirror and grating in the spectrograph were coated with a compound of silicon and carbon that made the telescope three to four more times as sensitive than it was during the ASTRO 1 flight. This means that less integration time was necessary to reach a desired signal-to-noise ratio for bright objects, and some objects previously too faint for study were observable.

The Ultraviolet Imaging Telescope (UIT) weighs 474 kilograms, is 81cm in diameter and is 3.7m in length. It has a 38cm diameter mirror of f/9 focal ratio and a 40 arc-minute field of view. A single frame of 70mm film images a field that is somewhat larger than that subtended by the Moon, with a resolution of about 2.0 arc-seconds. This is considered 'wide field' for astronomers.

Each UIT image covers more than 250 times the size of the Hubble's Wide Field/Planetary Camera, though at a lower angular resolution and sensitivity. For many galaxies or star clusters, this is large enough to encompass the entire object into a single photo frame. In addition, the UIT suffers from much less interference from visible light since it is provided with 'solar blind' detectors.

Deep wide field imaging is a primary means by which fundamentally new phenomena or astrophysically important examples of known classes of objects are recognised in the ultraviolet. The UIT, developed

by the Goddard Space Flight Centre in Greenbelt, Maryland is the key instrument for such activities.

It is a powerful combination of telescope, image intensifier and camera. Images are recorded directly on sensitive astronomical film for development after the flight. Two filter wheels with six filters each allow specific regions of the ultraviolet spectrum to be isolated for quantitative energy distribution studies.

The wavelength of the UIT covers the mid-section of the ultraviolet spectrum, from 1200 to 3200 angstroms. A thirty minute exposure, the length of one orbital night, recorded a 25th magnitude (extremely faint) blue star. The ultraviolet sensitivity of the UIT favours the detection of hot objects that emit most of their energy in the UV. Common examples span the evolutionary history of stars — massive stars and stars in the final stages of stellar evolution.

The UIT obtained a large number of images during the ASTRO 1 flight. Included in those images were clusters of young, hot massive stars, globular clusters containing old stars, spiral galaxies and small irregular galaxies. These images provided a wealth of information to astronomers. Images obtained during the ASTRO 2 flight will continue the work of imaging the ultraviolet sky.

The Wisconsin Ultraviolet Photo-Polarimetry Experiment (WUPPE) weighs 446 kilograms, measures 70cm in diameter and is 12.14m long. It is used to measure the polarisation of ultraviolet light from celestial objects. The Cassegrain type telescope has a 50cm f/10 mirror.

WUPPE examines UV radiation from 1400 to 3200 angstroms with a 3.3 x 4.4 arc-minutes field of view, and has a resolution of 6.0 angstroms. The light is fed into a Monk-Gilleson spectrometer, where two rotating wheels are used to select the focal plane aperture and the polarimetric analyser. The detector consists of dual Reticon self-scanning linear arrays of 1024 photodiodes, coupled by fibre optics to a microchannel plate with a cesium-telluride photocathode. A CCD camera acquires the target acquisition and views the aperture during a measurement.

Polarisation is a new tool for analysing astronomical sources and WUPPE measures the degree of polarisation in a part of the spectrum that was not investigated until the flight of ASTRO 1. It measures the polarisation by splitting a beam of light into two mutually perpendicular planes of polarisation, passing the beams through a spectrometer and focusing the beams onto two separate array detectors.

Photometry is the measurement of the intensity of radiation, whilst polarimetry is the measurement of its polarisation. In the ultraviolet spectrum, both techniques are extremely difficult to achieve with the high degree of precision required by astronomical studies. The effects being measured are very subtle, and the technical effort required to obtain and interpret high quality data is inordinate.

The targets of WUPPE investigations are primarily known objects in our galaxy and beyond, for which comparative data exists in other wavelengths. Like the Hopkins Ultraviolet Telescope, WUPPE is well suited for spectroscopic observations of hot stars, galactic nuclei and quasars. Since its wavelength coverage is from 1400 to 3200 angstroms, the two scientific instruments complement each other.

Although the Hubble Space Telescope makes polarisation measurements, the photometric precision of WUPPE is greater. Furthermore, because of its large field of view, WUPPE is much more sensitive than the HST for the measurement of extended objects such as nebulae.

WUPPE observed a variety of astronomical objects during ASTRO 1, including the interstellar medium, hot stars and active galaxies. The data collected allowed astronomers to refine their theories and develop a better understanding of the universe.

Initial checkout

Once the space shuttle *Endeavour* was launched at night, the flight plan called for a 20-hour checkout of the ASTRO payload to allow the observatory to be fine tuned. Observations began immediately after the checkout is complete, continuing throughout the flight with brief interruptions from waste water dumps and shuttle flight tests.

A night launching allowed the space shuttle to pass through the 'South Atlantic Anomaly' where high energy radiation dips closer to Earth than usual, on the day side of its orbit. High energy particles affect instrument operation and increase the background levels in electronic detectors. The 'natural' background such as scattered light and UV residual airglow emissions is also higher on the daylit side. The night time shuttle launch preserves orbital night passes for observations of the faintest and often highest priority astronomical targets.

The seven-member ASTRO 2 crew were divided into two 12-hour shifts, so astronomical observations could continue around the clock. The mission timeline, which is a detailed blueprint of flight science activities, was divided into two-orbit (three hour) blocks. One of the three telescope teams had priority for the whole time block and selected the observations that took place during that period. The other two telescopes observed the same object or something nearby.

A new feature for ASTRO 2 was 'community' involvement. Although each instrument was designed at a particular university or government facility, guest investigators also used the ASTRO telescopes for their own use. As well, scientists posted preliminary scientific results on the Internet as the flight is still proceeding.

Data for the flight was relayed through the Tracking and Data Relay Satellite System's TDRS-E and -W spacecraft, as well as the Ground Spacecraft Tracking Network. All ASTRO 2 data was routed to the Spacelab Data Processing Facility at the Goddard Space Flight Centre.

Launch time

The space shuttle *Endeavour* carrying the



Payload commander Tamara Jernigan looks at a display of data on the flight deck of Space Shuttle Endeavour.

STS 67 crew was launched from the Kennedy Space Centre in Florida at 12:38am (local time) on 2 March 1995. The launch was delayed by a minute because of several minor technical problems. The weather was also a concern after a cold front arrived in the area, but a clearing opened in low clouds and enabled the launch to proceed.

Commanding the flight was Steve Oswald, with rookie pilot Bill Gregory. Tammy Jernigan making her third spaceflight was the Payload Commander. The Mission Specialists, both making their first spaceflights were John Grunsfeld and Wendy Lawrence. The two Payload Specialists on STS 67 were Sam Durrance and Ron Parise, both of whom had flown previously on ASTRO 1 in December 1990.

On safely reaching orbit, the 'Red' team of Tammy Jernigan, Wendy Lawrence and Sam Durrance activated the ASTRO 2 payload whilst the 'Blue' team of Steve Oswald, Bill Gregory, John Grunsfeld and Ron Parise went to sleep.

Activation of the ASTRO 2 payload was slightly behind schedule, after a steering jet leak forced the closure of the telescopes' protective doors. The leak was in a reaction control system that was located in the right aft orbital manoeuvring system. Ground controllers worked with the crew on the problem, and eventually they closed the manifold that supplies oxidiser and fuel to stop the leak.

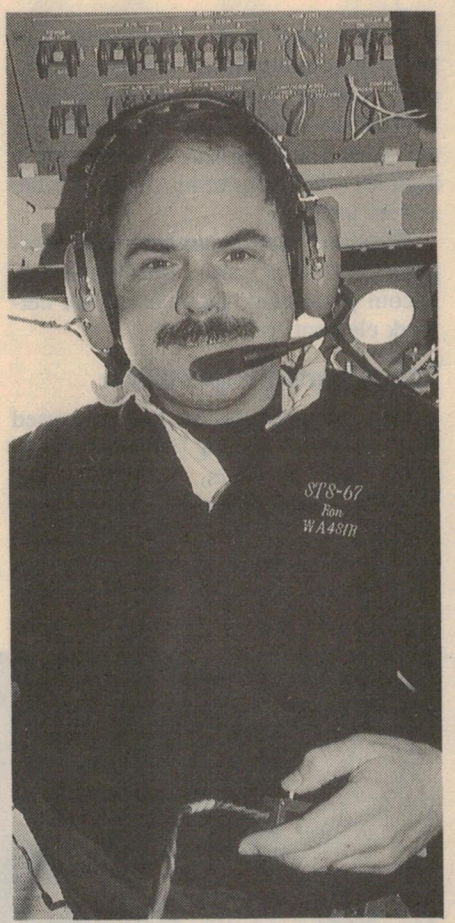
There was an Australian passenger on STS 67. Endeavour, an Australian space telescope, was making its second flight into orbit after a less than successful debut flight aboard *Discovery* on STS 42 in January 1992. Developed and built by AUSPACE Ltd, a Canberra based company, Endeavour was flown on STS 67 as part of the Get Away Special (GAS) project — small, self contained payloads that give individuals, students and private industry opportunities to fly experiments on the space shuttle.

The reason that Endeavour was flying on STS 67 was to take images in the ultraviolet spectrum of targets that included star forming regions, violent galactic events and nearby galaxies. The Australian space telescope was housed in two GAS canisters which were interconnected by a cable harness. One of the canisters is fitted with a motorised door assembly that protects the payload during launch and opens to allow observations to be made. This canister houses the telescope, detector and control computer.

Endeavour is a 100-millimetre binocular reflecting telescope. One side of the telescope allows all the light from celestial targets to enter the other side, which allows light in a narrow spectral band. Thus, by subtraction of the two signals, the narrow band image can be studied in detail as the brighter background is removed.

The detector is a very sensitive photon counting array which comprises an image tube, a fibre-optic dissector and charged coupled arrays. The detector counts individual photons produced by distant galaxies. The second canister contains the battery that supplies power to the payload and video cassette recorders that record the images for processing after landing. The telescope, which has a 2° field-of-view, relies on the space shuttle for pointing. Shuttle motion during exposures can be removed by ground image processing.

One new experiment that was conducted on STS 67 was the Middeck Active Control Experiment (MACE). MACE is a 1.8m long flexible beam with mock satellite instruments mounted at each end. It floated free and the



Payload specialist Ronald Parise used the Shuttle Amateur Radio Experiment (SAREX) to talk to students on Earth from the flight deck of the Space Shuttle Endeavour.

astronauts measured how disturbances caused by one instrument affect the performance of the experiments at the other end. The data gathered will assist engineers in designing more stable space structures.

Throughout the flight, all the crew members took time out to answer questions from the public via the Internet (URL:hhtp://astro-2.msfc.nasa.gov). This was the first time that the Net had been used in this way, and by the end of the flight some 200,000 computers in 59 countries had logged onto the ASTRO 2 home page. Two and a half million requests for information were recorded at the Marshall Space Flight Centre, and the popularity of the Net's debut will find it on all space shuttle flights in the future.

Another way of getting the public to participate in the space program is the Shuttle Amateur Radio Experiment, or SAREX. During the flight, 26 educational institutions from the United States, South Africa, India and Australia contacted the astronauts by ham radio and were able to speak with them about their flight.

All of the ASTRO 2 payloads worked well throughout the flight. One highlight was the simultaneous observation of the planet Jupiter by ASTRO 2 and the Hubble Space Telescope. Scientists looked for evidence of any changes in the planet's upper atmosphere after the collision of Comet Shoemaker-Levy with Jupiter in July 1994. As well, ASTRO 2 instruments observed volcanic eruptions on Jupiter's fiery moon Io.

Another highlight for ASTRO 2 scientists was the gathering of data to confirm or rule out the existence of helium in the intergalactic medium, in the quantities predicated by the 'Big Bang' theory. The WUPPE team of scientists looked at the star 51 Othluchl, which is in a class of rapidly spinning stars whose outer layers are seemingly being ripped off by their own stellar winds.

Twelve days into the mission, there was another first. Eight Americans were in space at the same time, after astronaut Norm Thagard was launched into orbit on a Russian Soyuz rocket to spend three months on the Russian Space Station *Mir*. Several days after his launch, Thagard was in radio contact with Steve Oswald who had flown with him on STS 42.

After the *Endeavour* had been in orbit for a fortnight, mission managers decided not to extend the mission past 15 days. But the weather at both the Kennedy Space Centre and Edwards Air Force Base in California played havoc with those plans. In the end, *Endeavour* landed at Edwards at 2:47 pm (local time) on 18 March 1995 after a flight of 16 days, 15 hours and 8 minutes — making it the longest space shuttle flight ever.

Following refurbishment, *Endeavour* was to fly again in August 1995 on the flight of STS 69. However, the future of ASTRO is not as clear. Currently there are no plans to refly the ASTRO payload, even though ASTRO 2 was a stunning success. Once the data from the flight is processed, ASTRO 2 will give us a new view of our universe which would not have been possible until recently.

In closing, the author wishes to thank Debbie Woods of the Johnson Space Flight Center; Jim Elliott, formerly of the Goddard Space Flight Center; and Kay Grinter of the Kennedy Space Center for their assistance in the completion of this article. All photographs shown are by courtesy of NASA. ❖

DIGITAL 'PIGGYBACK' SECURITY MONITORING

Sydney firm Pacom Data has developed a system which allows security monitoring data to be transmitted quickly and reliably over corporate data networks, interleaved with the existing data streams. This provides a very cost-effective solution for large distributed organisations such as banks.

Many of our financial institutions today are looking to advanced electronic systems to solve their internal security problems. Major Australian banks have adopted a relatively new technology to help solve the complex problems of centrally controlling a high degree of security at thousands of branches nationwide.

The technology now being used has been developed by Pacom Data Pty Ltd, a subsidiary of Australian public company Pacific Communications, with headquarters at Rydalmere in Sydney. The company's Pacom 1000 security system, called a Data Line Utiliser (DLU), enables organisations with existing corporate SNA or X.25 computer networks to transmit information relating to branch physical security over these same networks without in any way interfering with the flow of corporate data. The total integrity of such data is guaranteed and there is no degradation of performance or transmission speed.

The DLU was invented and developed by Pacom Data and is a proprietary technology. The Pacom 1000 system reduces the cost of running a dedicated network to communicate security equipment alarms to a central control room, whether internal or external, and offers substantial cost advantages as well as improved security surveillance performance.

Security information can be transmitted using a number of different techniques, and the equipment will operate in several different communications environments.

The Pacom system provides backup facilities to cater for computer network failures, dedicated line loss, modem failure and any fault in the Pacom primary central site equipment. The system can provide either proprietary central monitoring within the organisation itself, or alternatively a connection can be made to an existing security company's central monitoring computers. Each of the components which make up the system are fail-safe and provide a high security monitoring link to ensure system integrity.

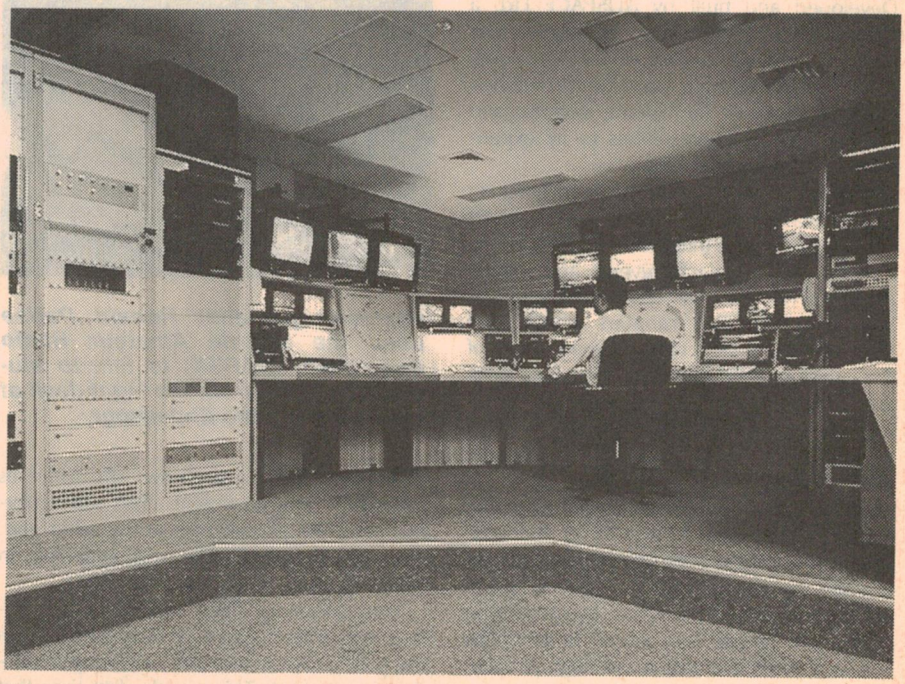
The three most commonly used computer networks are: transparent (a Pacom proprietary protocol), SNA network element and X.25.

Transparent operation

Multi-dropped leased lines are used by a number of leading financial institutions and retailers, including the National Australia Bank, to enable their branches to communicate with a data centre or network control point. A multi-point communicatrions protocol is used on these links that allows the terminal equipment, in other words the PC installed at the branches, to communicate with a host computer system located at a data control centre. Examples of multi-point communications protocols are: IBM SDLC; IBM Bi-Sync; Burroughs Poll Select; and Burroughs TD830.

The 'Transparent' mode of operation illustrated in Fig.1 enables branch alarms to be communicated to an alarm central station over multi-dropped leased line networks transparently to the multi-point communications protocol being used. The multi-dropped leased line is effectively shared between the Pacom equipment and the terminal equipment at the branch.

Co-existence of the alarm and terminal traffic is achieved by taking advantage of a particular characteristic of



The control centre at the Sydney Football Stadium, which uses a Pacom system — also used to control systems at the adjacent Sydney Cricket Ground.

multi-dropped leased lines — namely when 'dead time', or *latency*, occurs on these type of lines. Dead time is where the transmit or receive transmission path of the line is not in use for a number of milliseconds. It is during this dead time that the Pacom 1026 Alarm Interface Module and the Pacom 1011 Network Interface Processor exchange alarm information.

There are a number of significant benefits to the user of the Pacom transparent mode of operation. The security network does not require any network upgrades to support it, thereby avoiding associated costs. No changes to the network configuration are needed. All security data is kept independent of the network and the host computer, so that there is no danger of it interfering with existing corporate data. Security communications are maintained in the event of Front End Processor failure — this is an important feature towards guaranteeing uninterrupted security surveillance. The transmission of security data does not have any significant effect on the network response time.

SNA network operation

The Pacom 1000 system can provide three SNA connectivity options, all of which enable alarm messages to be passed either directly to an IBM host based alarm monitoring application or to a stand-alone PC or minicomputer based alarm monitoring application via the Pacom 1000 Base Station equipment. Westpac Bank is a major user of this mode of operation.

The branch equipment acts as a PU type 2.1/LU type 6.2, and communicates with a Pacom 1000 Base Station using the IBM Advanced Peer to Peer Networking (APPN) facility. This allows PU2.1 type devices to set up sessions directly with similar type devices, without the need for an intermediate application such as NRF. In this mode of operation the Pacom 1000 branch equipment establishes an SNA session directly with the 1000 Base Station. This mode of operation is illustrated in Fig.2.

Benefits to the user of the Pacom PU2.1/LU Type 6.2 mode of operation include: security equipment becomes a manageable network resource; total network compatibility for online systems and security systems; the security system is only dependent upon the host processor at session establishment time; standby Network Interface Processors

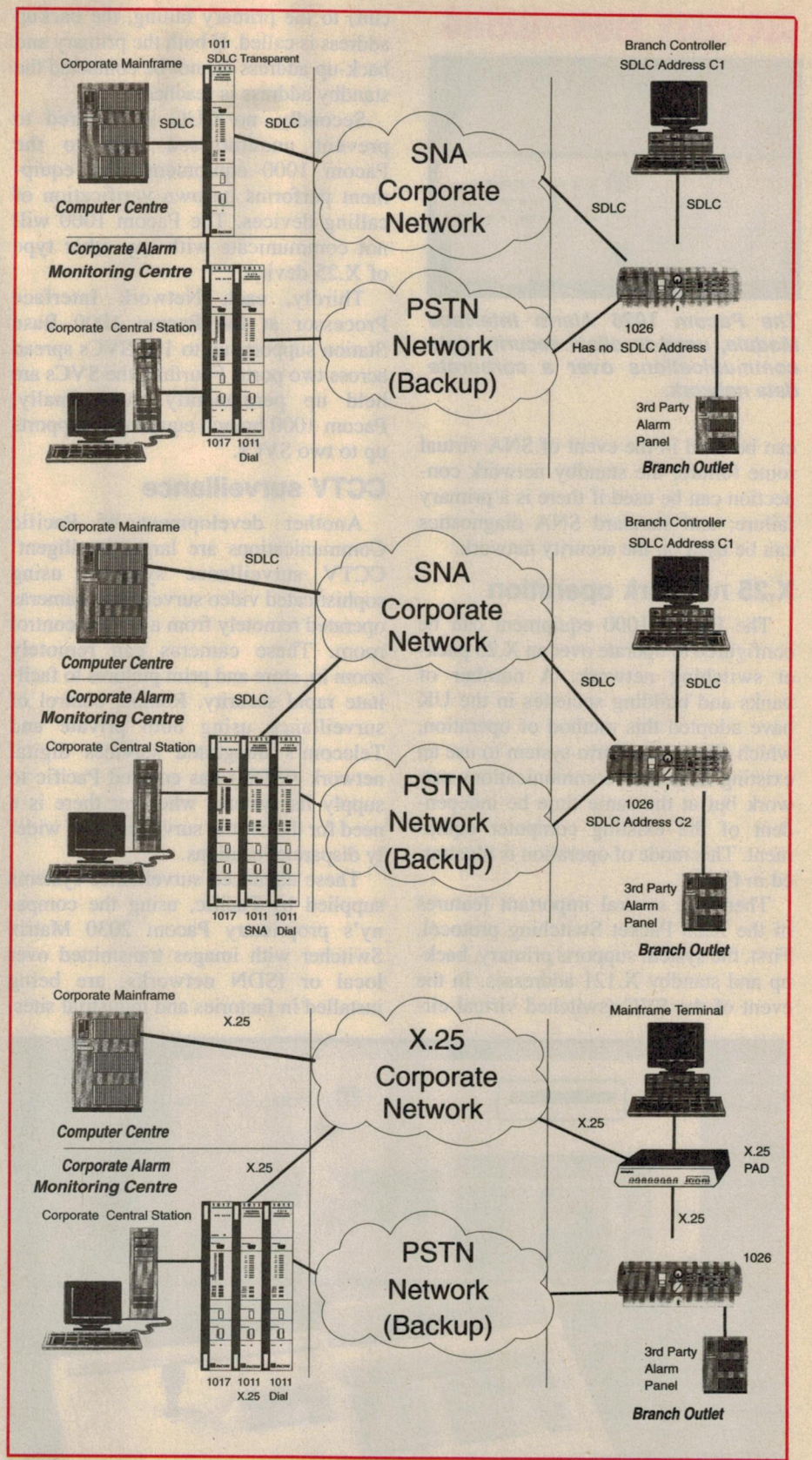
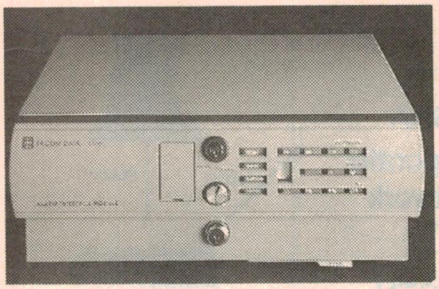


Fig.1 (top) shows the Pacom 1026 Alarm Interface Module used in a 'transparent' network, while Fig.2 (centre) shows it being used in an SNA end node, and Fig.3 (bottom) in an X.25 corporate network. In each case, the PSTN (Public Switched Telephone Network) is used for back-up communications.



The Pacom 1026 Alarm Interface Module, used to allow security data communications over a corporate data network.

can be used in the event of SNA virtual route failure; the standby network connection can be used if there is a primary failure; and standard SNA diagnostics can be used on the security network.

X.25 network operation

The Pacom 1000 equipment can be configured to operate over an X.25 packet switching network. A number of banks and building societies in the UK have adopted this method of operation, which allows the alarm system to use an existing X.25 data communications network but at the same time be independent of the existing computer equipment. This mode of operation is illustrated in Fig.3.

There are several important features of the X.25 Packet Switching protocol. First, the system supports primary, backup and standby X.121 addresses. In the event of the SVC (switched virtual circuit) to the primary failing, the backup address is called. If both the primary and back-up address cannot be contacted the standby address is reached.

Secondly, no CUG is required to prevent unauthorised calls to the Pacom 1000 equipment. The equipment performs its own verification of calling devices. The Pacom 1000 will not communicate with any other type of X.25 device.

Thirdly, each Network Interface Processor at the Pacom 1000 Base Station supports up to 100 SVCs spread across two ports. Fourthly, the SVCs are held up permanently. And finally, Pacom 1000 branch equipment supports up to two SVCs.

CCTV surveillance

Another development of Pacific Communications are large 'intelligent' CCTV surveillance systems, using sophisticated video surveillance cameras operated remotely from a central control room. These cameras can remotely zoom in, store and print pictures to facilitate rapid security. Remote control of surveillance using both private and Telecom's integrated services digital network (ISDN) has enabled Pacific to supply its systems wherever there is a need for the central surveillance of widely disparate locations.

These advanced surveillance systems supplied by Pacific, using the company's proprietary Pacom 2030 Matrix Switcher with images transmitted over local or ISDN networks, are being installed in factories and industrial sites; major leisure centres such as hotels and casinos; sports venues; airports, ports and other transport centres; government building and public places; and correctional centres.

GLOSSARY

SNA	System Network Architecture
PU	Physical Unit
LU	Logical Unit
APPN	Advanced Peer to Peer Networking
NRF	Network Routing Facility (IBM facility for intercommunication between branch office equipment)
Virtual Route	Communications path through SNA network
SVC	Switched Virtual Circuit
CUG	Called User Group (a security facility specifically for X.25 protocol)

Export led growth

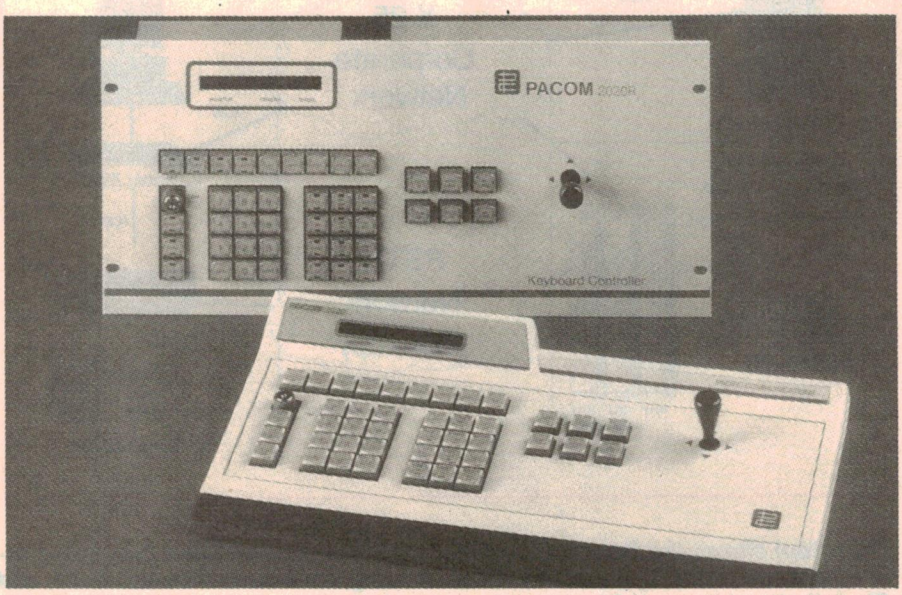
Up to the end of last year, over 8000 Pacom DLUs were sold in the United States, where the product is manufactured under licence by Mosler Inc. In the United Kingdom the company has entered into similar licencing agreements with Chubb Limited. Bell Security are also distributing the product range in the UK. With some 45% of total revenue derived from overseas sales, Pacific is enjoying an export led growth.

An important part of the company's marketing strategy is to focus on Asia. A wholly owned subsidiary, Pacom Asia Pte Limited, headquartered in Singapore, services the rapidly growing Asian market for electronic security systems. The busiest seaport in the world, the Port of Singapore, is guarded by a Pacific surveillance system.

In New Zealand, General Communications Pty Limited, a wholly owned subsidiary, is a major player in the country's security industry market.

Pacific Communications regards innovation as the key to future growth. Currently 5% of total revenue is spent each year on R&D. Recent successes can be directly related to the company's capacity to develop new and enhanced systems and products.

According to MD Dieter Monch, the Company's focus is on meeting security needs with a mix of electronics engineering and telecommunications technology, and its objective is to develop and refine proprietary products for the security industry which make even greater use of these disciplines. ❖

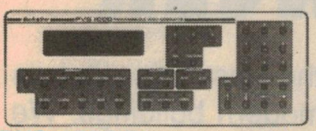


The Pacom 2020 keyboard controller, which becomes a command console for any of the 2000 series video security switching systems.

Black Star

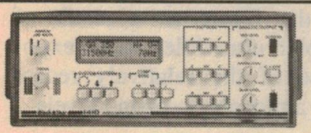
British Design, British Manufacture, British Quality

...but at a price to suit your pocket!



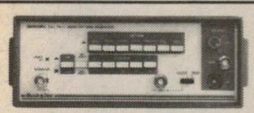
PVG 1000 Programmable Video Generator

• 110 MHz Dot Clock • 256 Colours displayed at 110MHz from colour Palette of over 16 million • All timing parameters programmed from front panel • Autosequence of selected patterns and systems • 1Mbyte frame memory • 2 Line LCD Display • RS232 Interface to PC or Terminal



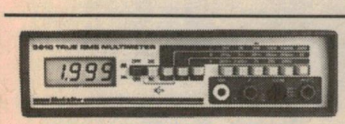
1410 Video Monitor Tester

• M ulti format • Microprocessor Controlled • Intelligent Alpha/Numeric Display • Analog-RGB, TTL-IRGB, Secondary RGB, Horizontal/Vertical/Composite Syncs. • Colour Bars, Testcard, Crosshatch, Dots, Ramp, Focus, Horizontal Lines, Vertical Lines, Raster, Checkerboard • 15.625 kHz to 48.5 kHz line and 49.9Hz to 87Hz frame frequencies • Easy connection via 9-way and 15-way 'D' and BNC, connectors• Alternate factory preprogrammed versions covering other systems at extra cost.



ORION PAL TV/VIDEO PATTERN GENERATOR

• Test TV, VCR, Monitor • PAL B,D, G, H, I, K • RF, Composite Video, and IRGB O/P's • Colour Bars, Purity, White, Greyscale, Crosshatch, Dots, Vert./Horiz. Lines, Focus • Separate or Mixed Syncs. • Composite Video O/P• Variable Video O/P• 5.5, 6.0, 6.5 MHz Sound Carriers • Trigger O/P • Line Frequency 15.625kHz • Frame Frequency 50Hz



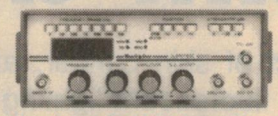
3210, 3210MP, 3225, Digital Multimeters

"Portable but not pocketable"

• 3 1/2 Digit 0.5" LCD • Battery operated • >7000 Hours Battery Life • 0.1% Basic DC Accuracy (0.25% 3225) • AC True RMS (3210) • Continuity Buzzer • 100µV - 1000Vdc • 100µV - 750Vac • 100nA -10A ac & dc • 100mΩ - 20MΩ Resistance • Diode Test

3210MP and 3225MP

All specifications as above except units are mains powered only. Supplied with shrouded test leads.



Jupiter 2010 Function Generator/Counter

• High speed & resolution at low frequencies • *FUNCTION GENERATOR* 0.2Hz to 2MHz• Sine, Square, Triangle, TTL (30) Outputs • High Quality Waveforms • 50/600Ω Outputs • External Sweep Facility • O, -20dB, 10dB Attenuator • Output O to 20V p-p • Output DC Offset -10V to +10V *FREQUENCY COUNTER* 20MHz • High Speed Reciprocal Measurement • Microprocessor Controlled • Internal/External Input • 4 Digit LED Display



Jupiter 2000 Function Generator

• 0.2Hz to 2MHz • Sine, Square, Triangle, • TTL (30) output • High Quality Waveforms • 50/600Ω Outputs • External Sweep Facility • O, -20dB, -40dB Attenuator • Output Amplitude 0 to 20V p-p • Output DC Offset -10V to +10V

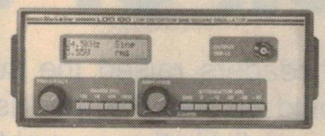
Jupiter 500 similar but 0.1Hz to 500kHz



4503 Intelligent Multimeter With Built-In IEEE-488/RS-232

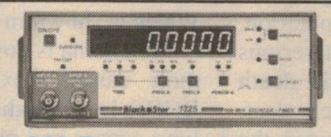
• Full 'Talk & Listen' • 4 3/4 Digit LED • Built-in IEEE488 & RS232 Interfaces • Autoranging • ±0.03% Basic Accuracy • AC True RMS • Auto Calibration • 1000 Vdc, 750Vac • 10A AC & DC • 40MΩ Resistance • Safety Sockets • Null, Hold , Continuity, Filter, Diode Test, dB, % Deviation, Ax+b, Rel • 40,999 Count • Mains Operation

Supplied complete with demonstration software on floppy disk for IBM and compatible PCs.



LD0100 Low Distortion Sine/Square Oscillator

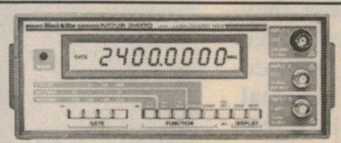
• Microprocessor controlled high quality sine/square oscillator • 10Hz to 100kHz • High Quality Waveforms • Bounce Free Output • 0.003% distortion • Rapid Response • Frequency Display • Amplitude Display • Rotary Controls • >60dB attenuation • >5V RMS Output



1325 Frequency Counter/ Timer

The Black Star 1325 measures frequency and period from 5Hz to 1.3GHz. The microprocessor controlled reciprocal measurement technique gives a fast response and high resolution at all frequencies.

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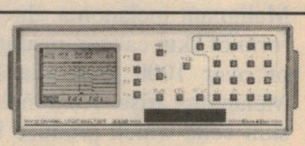
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2308 I/O INTERFACE

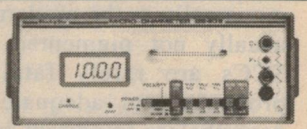
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An authority on skin cancer discusses

FLUORESCENT LIGHTS AND THE RISK OF SKIN CANCER

Last year a number of readers raised the subject of skin cancer, and the possibility that its increasing incidence could be linked to the use of fluorescent lighting in modern buildings. We sought the advice of a specialist in this area at the Sydney Melanoma Unit, and although extremely busy, he has now been able to provide us with the following informative article.

by JOHN F. THOMPSON
MB BS, BSc(Med), FRACS, FACS*

Skin cancer is a major public health problem in Australia, ultimately affecting over two thirds of the population. Malignant melanoma, the most serious form of skin cancer, results in the death of over 1000 Australians each year. Melanoma arises from melanocytes, the skin cells which produce the dark pigment melanin and under normal circumstances are responsible for the development of a tan following exposure to the sun.

The more common forms of skin cancer, basal cell carcinoma (BCC) and squamous cell carcinoma (SCC), arise respectively from the basal cells and the more superficial squamous cells in the epidermis, and are usually not pigmented. BCCs and SCCs are rarely fatal if treated promptly and adequately, but are nevertheless important because they require the expenditure of large amounts of the nation's limited health resources, and at a personal level cause a great deal of inconvenience, discomfort and disfigurement. A melanoma which has developed on a patient's back and an SCC which has arisen on another patient's ear are shown in Figs.1 and 2.

Steadily increasing

Australian figures for melanoma incidence are rising steadily, in keeping with a world-wide trend. In 1979 the incidence was 16 new melanoma cases per 100,000 population per year. In 1984 it was 20/100,000/year, and in 1990 (the last year for which national figures are currently available) it was 28/100,000/year. The rising trend in melanoma incidence in New South Wales is shown in Fig.3.

Melanoma is now the third most common cancer (excluding SCCs and BCCs) in Australia, both in men (after lung cancer and prostate cancer) and in women (after breast cancer and bowel cancer). There is no sign of any slowing of the rise in incidence, indeed there is concern that it may increase even more rapidly in the future as a result of increased solar ultraviolet (UV) exposure because of the relatively recent depletion of atmospheric ozone levels.

Role of sunshine

One of the main causes of skin cancer

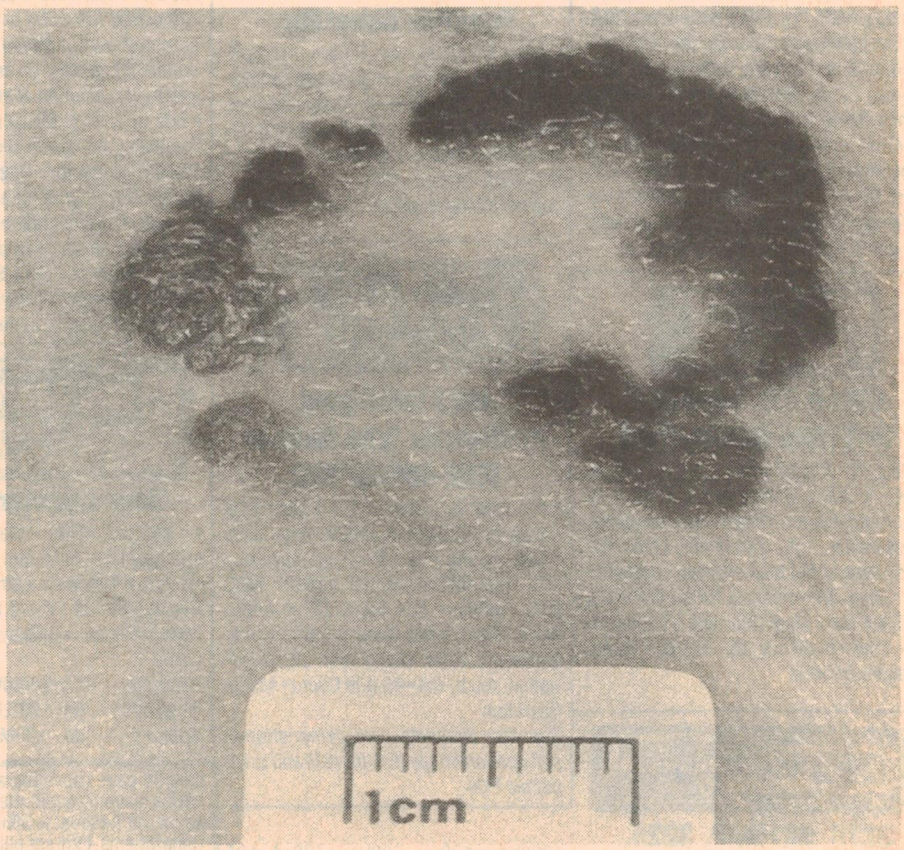


Fig.1: A malignant melanoma of the 'superficial spreading' type, on the back of a 32 year old woman.

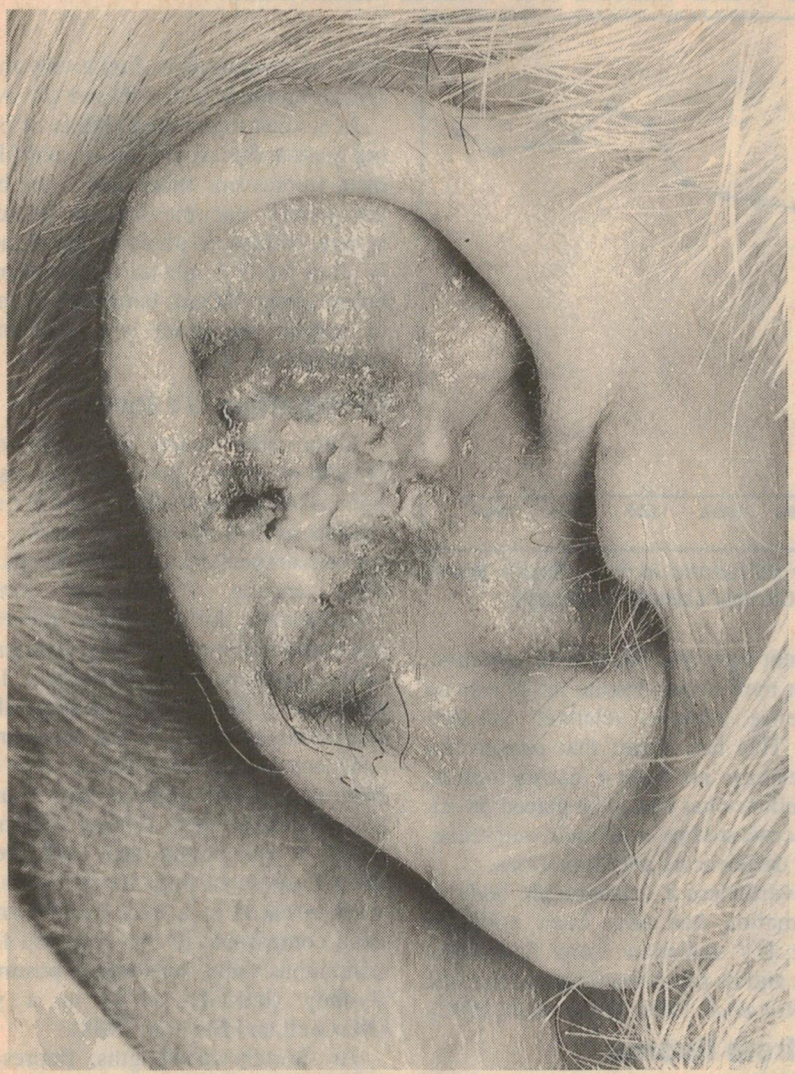


Fig.2: A squamous cell carcinoma (SCC) on the ear of a 67 year old man.

is exposure to sunlight, in individuals who are genetically susceptible to skin damage. Those with pale complexions, fair or red hair and blue eyes are at greatest risk, whereas skin cancer is rare in dark skinned races.

The high proportion of the Australian population with Celtic ancestors (from Ireland, Scotland and Wales in particular) is undoubtedly responsible for the fact that Australia has the highest incidence of skin cancer in the world, since high levels of solar exposure from earliest childhood are almost inevitable for anyone who grows up in this country.

It has become clear that *intermittent* solar exposure is more likely to cause melanoma than regular daily exposure. This is consistent with the observation that indoor workers who have intermittent outdoor recreational activities (e.g. at weekends and during holidays) are more likely to develop the disease than outdoor workers who are exposed to sunshine each day.

Strong evidence that the development of melanoma is related to solar exposure comes from the observed gradient in incidence from north to south of the country. In Queensland the incidence is 45/100,000/year, with a lifetime risk of developing melanoma of one in 22. In New South Wales the incidence is 32/100,000/year, with a lifetime risk of one in 30. In Victoria the incidence is 22/100,000/year, with a lifetime risk of one in 45.

Non-solar UV exposure

It is nevertheless apparent that factors besides sunshine and genetic susceptibility may also be involved in the development of skin cancer. The alarming statistics which indicate a steadily increasing incidence of malignant melanoma world-wide have focused attention on these other possible factors.

Of particular interest and potential importance is the possibility that UV exposure from sources other than the sun may be involved in the initiation of skin cancers. There is a wide range of these non-solar UV sources to which many people are regularly exposed. They include fluorescent and halogen lights, sun beds and sun lamps, photocopiers, projector lamps, card readers, insecticidal lamps and welding equipment.

UV-A, UV-B, and UV-C

Although UV light represents only a very small segment of the electromagnetic spectrum, it appears to be critically important in initiating the cell damage which can subsequently result in the development of melanoma and other forms of skin cancer.

Within the UV range, most evidence indicates that the particular wavelengths of light which are mainly responsible for the initiation of melanoma and other skin cancers are in the UV-B area (wavelengths 280-320nm).

Both animal experiments and clinical studies in humans strongly support the proposition that UV-B exposure increases the risk for melanoma development, as well as the risk for non-melanoma skin cancers. However, the possibility that UV-A (wavelengths 320-400nm) and UV-C (wavelengths less than 280nm) are also damaging cannot be discounted.

Particular interest has recently been aroused by a study in a primitive fish species which often develops melanoma spontaneously. In this particular fish (genus Xiphorus) it was shown that UV-A was considerably more potent in causing melanoma than UV-B. The relevance of these findings to the development of melanoma in man is uncertain. At the molecular level it appears likely that the wavelength of the energy reaching the skin may be more important than its intensity, causing damage to the DNA in cells (which in turn is thought to lead to the development of skin cancer).

When considering non-solar sources of UV radiation, it is important to be aware that the sources vary greatly in the absolute amounts and relative proportions of UV-A, UV-B and UV-C which they emit. And whilst UV-A from

FLUORESCENT LIGHTS AND THE RISK OF SKIN CANCER

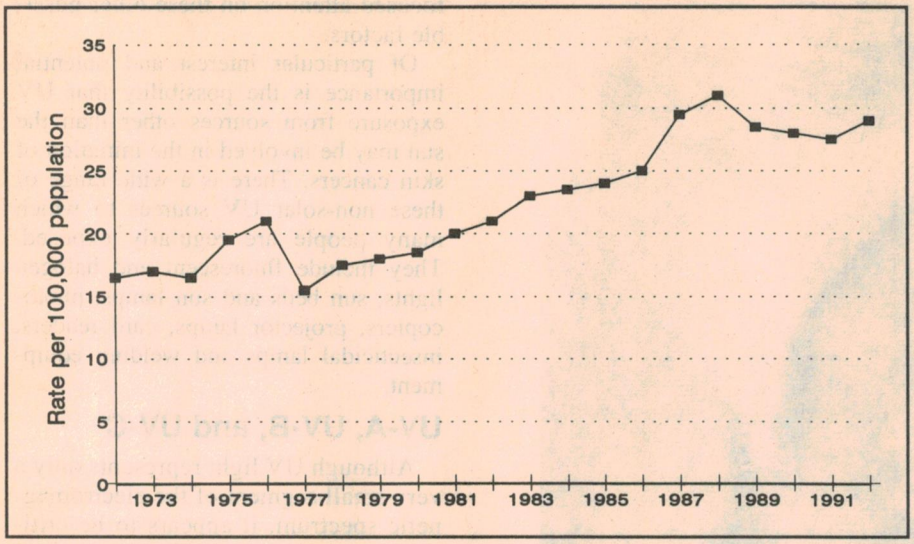


Fig.3: The steadily rising trend in melanoma incidence in New South Wales (based on information published by the NSW Central Cancer Registry).

solar exposure may not be of great importance in producing skin cancer, non-solar sources of UV light can emit amounts of UV-A far in excess of the amounts reaching the earth's surface from the sun.

It is also important to recognise that so called 'UV-A' sun lamps and sun beds can emit substantial amounts of UV-B and UV-C in addition to high levels of UV-A (and there is now considerable evidence suggesting that individuals who use sun lamps are at increased risk of developing SCCs, BCCs and melanomas).

Fluorescent lights

Fluorescent lights as a source of UV radiation have been subjected to particularly close scrutiny. This is because it has been postulated that their progressively more widespread use over the last 30-40 years could be responsible, at least in part, for the rising incidence of melanoma.

Several major epidemiological studies into the relationship between fluorescent light exposure and the development of melanoma have been undertaken. The first of these, reported in 1982, was of 274 Australian women with melanoma, and the results suggested that exposure to fluorescent light at work was associated with a doubling of the melanoma risk (Beral *et al*, 1982). Some of the subsequent studies have also found an increased risk, but the majority have failed to confirm the association.

Such investigations have been particularly difficult because exposure to fluorescent light has become so common, whilst melanoma, despite its increasing incidence, remains relatively uncommon. This has meant that *prospective* studies have not been a realistic option, and reliance has had to be placed on retrospective studies, with their well recognised deficiencies and limitations.

Nevertheless a considerable body of information has now been collected about UV radiation from fluorescent lights and its possible effects on the skin (see Roy *et al*, 1989; Walter *et al*, 1992).

UV from fluoros

In fluorescent lamp tubes an electrical current is passed through mercury vapour at low pressure. Excitation of the mercury atoms produces electromagnetic radiation, principally in the invisible UV region. The main emission is at 254nm, in the UV-C range, but there are also peaks at higher wavelengths in the UV-B range (at 185, 297, 303 and 313nm) and the UV-A range (at 334 and 365nm).

Visible light is produced when the 254nm radiation causes fluorescent activation of the coating of powdered phosphor on the inner surface of the glass tube. The glass, although it is thin, absorbs most of the UV radiation below about 290nm, but higher wavelength UV radiation is transmitted. The situation is thus similar to that which pertains for solar radiation, since much of the shorter wave length UV radiation in the solar spectrum (i.e. below about 290nm) is absorbed by the earth's atmosphere, principally by the ozone layer, whereas there is transmission of relatively much greater amounts of UV-B and UV-A.

In studies to date the effects of placing glass and plastic diffusers and filters over fluorescent tubes have not been adequately documented. A standard styrene diffuser is likely to absorb nearly all of the UV light with a wavelength below about 360nm, but diffusers made of acrylic are much less efficient in removing UV-B.

Comparing UV levels

Fluorescent tubes can emit over 600uW of energy per lumen of visible light. The corresponding value for sunlight is around 400uW per lumen, and for conventional incandescent lamps it is only around 75uW per lumen. Considerable attention has therefore been paid to the relative contributions of solar exposure and fluorescent light exposure to the total UV dosage which individuals receive from the two sources.

In one study, when the relative flux from solar and fluorescent light sources at wavelengths near 295nm was measured, it was found that exposure to daily fluorescent light for 40 hours per week resulted in a total annual irradiance comparable to that received from continuous daily sunshine exposure in Sydney (latitude 34°S) in a year (Maxwell and Elwood, 1988).

At shorter wavelengths, fluorescent lights emitted a much greater flux than the sun. For example at 290nm, still well within the UV-B range, fluorescent tubes emitted between 10 and 30 times the solar emission. At even shorter wavelengths the solar energy was extremely low, whereas low intensity fluorescent emissions persisted.

However, it must be appreciated that most of the UV-B spectral irradiance from solar exposure is at wavelengths greater than 295nm. Thus the total UV-B irradiance from solar radiation is over 1000 times greater than that from standard undiffused fluorescent lighting, and at least 10,000 times greater when the fluorescent tubes are covered by standard plastic diffusers. The newer 'compact' fluorescent lamps are reported to have considerably lower outputs of UV-A, UV-B, and UV-C than conventional fluorescent tubes.

The sunburn producing effect of UV radiation can be measured in 'minimal erythemal doses' (MEDs), where one

MED is the amount of radiation required to produce just-discernible redness (erythema) of previously unexposed skin.

UV-B is around 1000 times more effective than UV-A in producing sunburn. In an average working year (2000 hours) beneath undiffused fluorescent lights, an exposure of less than 10 MEDs will be received. The annual personal exposure to UV radiation in Australia varies with geographic location, occupation and life-style, but is usually in the order of 300-600 MEDs.

Fluorescent lights and skin cancer

Although human exposure to fluorescent lights is thus most unlikely to result in *total* UV-B doses which are greater than those occurring as a result of exposure to sunlight, fluorescent lights may produce greater exposure to lower wavelengths within the UV-B spectrum.

It has been postulated that these lower wavelengths of UV-B, or perhaps specific wavelengths at the lower end of the UV-B range, might be more likely to initiate the development of melanoma by exerting a specific damaging effect on DNA in the pigment-producing melanocytes within the skin. If this was confirmed, it could explain the possible association between fluorescent lights and melanoma. Other non-solar sources of UV radiation, previously mentioned, might also contribute to the development of melanomas, BCCs and SCCs by a similar mechanism.

In this discussion it must be emphasised that a relationship between non-solar UV radiation and the development of skin cancers in man is far from proven. In 1989, the International Radiation Protection Association (IRPA) recommended that UV-B exposure of unprotected skin or eyes within an eight-hour period should not exceed the equivalent of $30Jm^{-2}$ at 270nm. For undiffused fluorescent light, the time to exceed the IRPA limit is greater than 400 hours.

In the same year, however, a Consensus Development Conference Statement from the National Institutes of Health in the United States considered the whole question of sunlight, ultraviolet radiation and the skin, and concluded that the long term effect of exposure to fluorescent lights was 'an unresolved issue'. And in a more recent publication (Walter *et al*, 1992) in which a new study was reported and the matter thoroughly reviewed, it was considered on the basis of the results obtained, previous epidemiological studies and clinical and animal evidence that fluorescent light exposure remains a potential risk for melanoma.

*The Author

Mr John Thompson is Associate Professor in Surgical Oncology in the Department of Surgery, University of Sydney and also Deputy Director of the Sydney Melanoma Unit at Royal Prince Alfred Hospital, Sydney.

Quartz halogen lamps

The quartz halogen lamp has become increasingly popular both for general indoor lighting and for desk lighting in recent years. It consists of a quartz bulb filled with a halogen gas (usually iodine) and containing a tungsten filament.

The gas minimises tungsten evaporation from the filament, allowing it to be operated at a higher temperature than a conventional incandescent lamp, whilst at the same time prolonging the lamp's life. Because the operating temperature of the filament is higher, more UV radiation is emitted, and this passes without significant attenuation through the quartz bulb.

The amount of UV radiation which reaches the skin of an individual using a quartz halogen lamp depends on the power and specific emission characteristics of the lamp, the design of the lamp holder and reflector, the distance from lamp to user, and the duration of use.

If these lamps are used for several hours each day at short distances (around 25cm is not uncommon for halogen desk lights), the eight-hour occupational limit for UV radiation recommended by the Australian National Health and Medical Research Council is likely to be exceeded.

Halogen downlights and uplights are usually located with relatively large distances between lamp and user, greatly reducing the UV radiation hazard. As with a fluorescent light, a glass or plastic filter will greatly reduce the amount of UV radiation reaching the lamp user from a quartz halogen globe. A 3mm glass filter, for example, will reduce effective UV irradiance at least 300 fold.

Reducing the risks

The dangers of solar UV exposure are now well established, and it is clear that there is an urgent need for all Australians to be protected from unnecessary or excessive exposure to sunshine from earliest childhood and throughout life if the incidence of skin cancer is to be reduced, and the death toll from melanoma controlled. Those with fair complexions need to be particularly careful to avoid sunshine and especially to avoid heavy intermittent exposure, particularly if it causes sunburn.

The possibility that non-solar sources of UV radiation such as fluorescent and quartz halogen lights *may* also cause or aggravate skin cancer must also be borne in mind, and precautions taken wherever possible. Covering fluorescent tubes, quartz halogen lamps and other sources of UV radiation with plastic or glass filters or diffusers should help to minimise the risks, and effective filtration should be part of the original manufacturer's design. This should be considered when purchasing new lighting equipment.

When a filter is not fitted, the distance between lamp and user should be increased. For an unfiltered quartz halogen desk lamp with a 20W globe, for example, a minimum separation of 500mm is recommended; for a 35W globe a minimum separation of one metre; and for a 50W globe a minimum separation of 1.5m.

Finally, early recognition of skin cancers which may develop despite all precautions is of critical importance if treatment is to be successful. ❖

Further reading

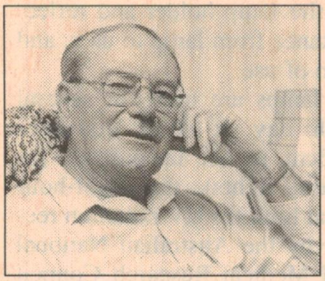
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Maxwell KJ and Elwood JM: 'Could melanoma be caused by fluorescent lights? A review of relevant physics'. *Recent Results in Cancer Research* 102:137-143, 1986.

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When I Think Back...

by Neville Williams

Victor Harris: A lifetime commitment to seeking top performance from analog discs - 2

Having addressed himself in the immediate post-war years to the design of professional quality phono pickups, Victor Harris helped set new world standards with his HH and MBH models, designed and produced in Australia. He carried through into the stereo era, meanwhile producing supplementary analog equipment well regarded by both professional engineers and the hifi fraternity.

. Because he was aware of their requirements and accessible as a local manufacturer, Vic had won ready support postwar from Australian broadcasting stations, recording studios, theatre operators and advertising agencies.

However, in a 1988 lecture to the Gramophone Society, Vic said that the arrival of stereo had signalled the end of his time-proven MBH leakage flux mono pIckups, described in the previous chapter. He had had to develop a completely new stereo pickup exhibiting comparably low stylus moving mass, low tracking pressure and a well suppressed natural resonance high up in the spectrum. To these basic requirements, it had been necessary to add high horizontal and vertical compliance, and complementary output signals for two separate channels — left and right.

Surveying the scene, Vic said that some stereo designers had resorted to 'subterfuges' to disguise certain limitations — e.g. a too-prominent resonance peak, by using a cantilever with controlled flexing or specifying a capacitor across the output circuit. Such measures were not acceptable in a quality product.

To date, moving magnet or induced magnet systems seemed to have been favoured by most designers. Moving coil designs presented an inherent difficulty with high moving mass and tracking pressure, although Vic conceded that this last need not present a problem if kept below four grams.

Although his own leakage flux design had been eminently successful for mono, it was not a candidate for replaying stereo discs because the moving mass was not symmetrical: "For lateral movements", said Vic, "only about half the mass of the stylus is referred to the tip; for vertical modulation, the entire stylus had to be moved up and down".

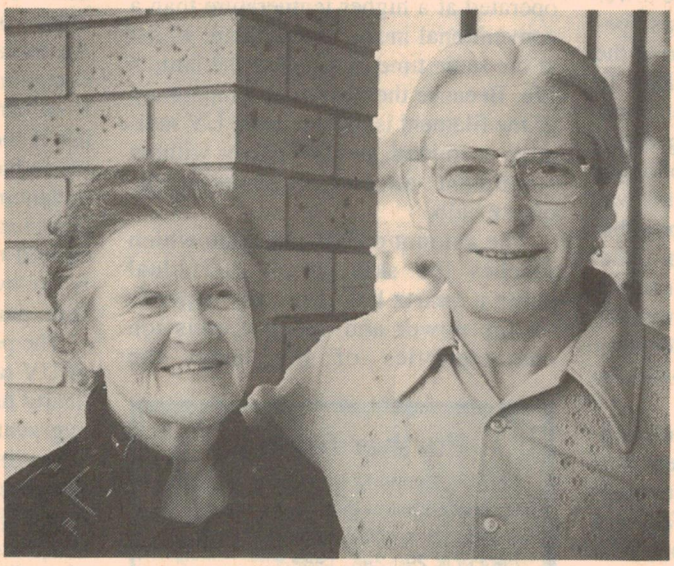


Fig.1: Vic Harris as many of his friends will remember him — just when he seemed to be gathering strength for renewed activities. He died suddenly on May 31, 1995, aged 77. His wife died only a few weeks later.

Vic said that for new his MBH type-L stereo pickup he had opted for the moving magnet principle for the following reasons:

(a) It made for robust construction, in which the actual stylus assembly was the only vulnerable component.

(b) It allowed for ease of stylus changing.

(c) The coils could be completely sealed against corrosive penetration. This would not have been practical with moving coils.

(d) The output could be sufficiently high to obviate the need for step-up transformers or preamplifiers.

The magnet in the new MBH design (Fig.2) was a short bar which 'pivotted' in the middle of an elastomeric block. In effect, pivotting at the geometric centre of four pole pieces, it became a push-pull device; as one end of the magnet is approaching a given pole piece and receding from the opposite one, the other end of the magnet is doing the converse. He continued:

"The pickup is really like two pickups. The side pole pieces (not shown in Fig.2) sense lateral movements of the stylus, and the top and bottom pole pieces sense the vertical movements. Each pole has its own coil and the

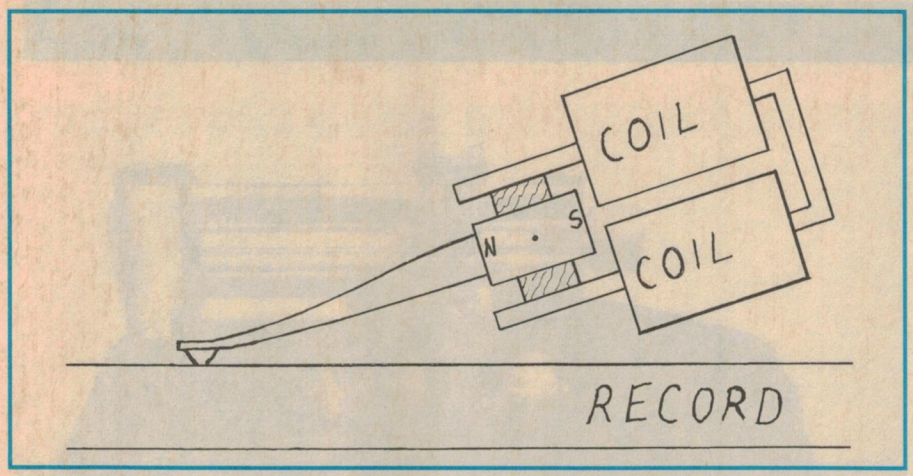


Fig.2: Adapted from Vic's own sketch, illustrating the operating of the Type L stereo pickup, relative to vertical deflection only. A second pair of coils and pole tips (not shown) sense lateral deflection of the stylus, with the two systems wired to produce left/right stereo signals.

method of interconnecting the coils — patented by MBH — yields the required sum-and-difference stereo resultants."

Explaining its physical construction, Vic told his audience: "The four coils and pole pieces form a composite assembly which is later encapsulated into the head. A square pocket is left in the moulding to accept the stylus assembly."

MBH literature quotes the vertical trailing angle as the (stereo) standard 15°, along with the option of two factory preset playing weights: 1.5 grams for extended stylus life, and a ruggedised version at 3.0gm. Either way, the response measures within +/-2dB from 20Hz to 20kHz, with no difference in the subjective sound quality between the two versions.

A spherical diamond stylus tip was fitted as standard, but an elliptical tip could be supplied to order. Vic was said to be wary of elliptical tips, however, because microscopic inspection of even prestige pickups revealed a problem: the tip was frequently misaligned relative to the groove.

In association with the Equidyne series arms, the type L stereo head climaxed the MBH pickup range which had been central to Vic Harris' career as a manufacturer of hifi equipment. (Subsequent variants were types -M, -N and -P).

A type L/M/N or P stereo head was the natural choice for private enthusiasts, who were as like as not to retain their mono heads for as long as they still had a use for their mono record collection. Such was the brand loyalty of MBH customers, according to Peter Stinson, that they rarely abandoned once-treasured older models, preferring to retain them "for old time's sake"!

Even before AM stereo broadcasting began, a few AM stations also installed MBH type L pickups to play new stereo library discs, rather than risk damaging them by playing them with a mono pickup. A miniature solid-state equaliser was developed by MBH (Fig.3) to blend the stereo pair into a mono signal suitable for feeding typical mono mixing consoles.

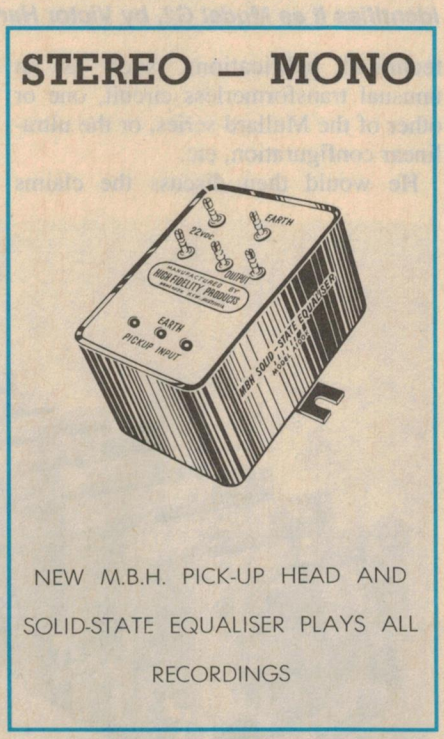


Fig.3: Tucked in under a motor board carrying an MBH Stereo pickup, this little solid state equaliser could deliver a signal switchable and correctly equalised for stereo or mono sound — from a stereo disc.

More than pickups

To this juncture, the Vic Harris story has been confined largely to phono pickups but there is much more to his overall hifi career, extending over at least 45 years.

In an article jointly prepared around 1990 for the Phonograph Society Magazine, Peter Stinson and Richard Dibbs said that Vic Harris had earned his right to comment on small-scale, precision engineering by his formal technical training and his ready acceptance by the Model Engineers Society.

Having also developed a keen interest in recording on acetate (lacquer coated) discs, one of his early observations from his one-man engineering business in 1946 was a criticism of certain imported recording lathes as being of 'sloppy design' with 'poor workmanship' and, by inference, overpriced.

Challenged to do better, he designed and produced a batch of recording lathes which have since become a valuable collector's item (see Fig.4). How many were in the batch is uncertain, but a couple of them have ended up in Peter Stinson's own collection of MBH memorabilia. Well engineered, Peter says, the recorder is assembled on a cast base and, while commendably firm and rigid, is in no sense cumbersome.

Having produced a satisfactory recording lathe, Vic Harris became acutely aware that there was a desperate need for a lightweight pickup — hence the Hummelstad Harris magnetic model produced in 1947 and described in the previous chapter.

Although produced as a spin-off from the recording lathe, the HH pickup was a unique product in its own right, which found its way into professional situations such as recording studios and broadcasting stations, nation-wide.

In turn, the need arose for matching transformers, equalisers and filters and who better to consult than the team who had produced the HH pickup? Vic Harris and Greg Hummelstad!

New factory

Ultimately, the garage-workshop proved too restrictive and in 1954, Vic embarked on the construction of a new

Flemington, making provision for three or four extra full-time employees. With the new factory came new trading names: 'High Fidelity Products' and 'MBH Audio Sales'. (The address was frequently quoted as Marlborough Road, Homebush West.)

While, on occasions, I may conceivably have driven down Marlborough Road, I have no recollection of ever having been conscious of Vic's factory — a modest brick building with the name in equally modest lettering above the front entrance.

What I have seen since is a set of prints showing racks, cupboards and shelves inside the building, stacked with test instruments, dies and tools which had been accumulated over the years as production aids.

The pictures had been taken, I gather, as a kind of photographic stock list of the equipment on hand. To me, they were mute evidence of a very tidy and methodical proprietor.

Settled into the new factory, Vic Harris had the satisfaction of knowing that his pickups and allied products had penetrated into about 80% of the local professional consumers, selling against Decca, HMV and other big-name products. In fact, EMI in the UK were using them to evaluate master recordings, and there were other inquiries about high performance turntables and complete free-standing studio playing desks.

To top it off, All-India Radio expressed interest in a complete MBH record playing system and having appointed High Fidelity Products as their principal supplier, bought several hundred turntable/pickup sets over a period of 10 years or more. In addition they bought a similar number of separate pickups.

Not surprisingly, there were also frequent inquiries for built-up amplifiers, on the assumption that an expert in pickup technology should be in a position to recommend or supply amplifiers of comparable merit. In fact, Vic Harris never professed to be an expert at electronics and tended to consult others before settling on a new design.

In their joint article, mentioned earlier, Messrs Stinson and Dibbs said that, when faced with the need for a new free-standing amplifier, Vic might typically select a leading-edge design featured in technical publications, such as an unusual transformerless circuit, one or other of the Mullard series, or the ultra-linear configuration, etc.

He would then discuss the claims and/or commission the services of people like Greg Hummelstad, Wal Buckland of EMI (Aust), Brian Beames, Craig Perkins, or Ross Sheard.

Having decided on the merits of the



Fig.4: One of Vic Harris' early recording lathes, in Peter Stinson's collection of MBH memorabilia. Note the on-board microscope and the identity plate, which identifies it as Model G2, by Victor Harris of Knocklayde Street, Ashfield.

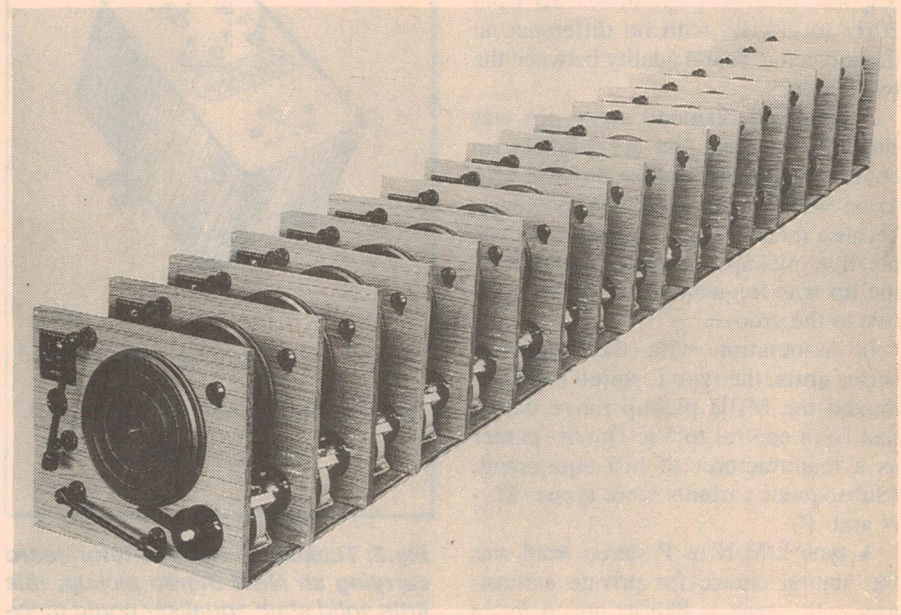


Fig.5: Photographed around 1965, a stack of studio disc players ready for despatch to All-India Radio. Keeping up with this contract probably limited MBH's penetration into the retail market.

particular circuit, adapted it as necessary and nominated the most reliable components, it and possibly a batch like it would be built up in the factory, under the MBH brand name, for sale to clients.

In the mid 1950s, Peter Stinson recalls, Vic became involved with a 'transformerless' amplifier featured in an overseas lab report.

Having in mind that the output transformer could arguably be the most expensive and the most contentious component in a valve amplifier, the prospect of marketing an amplifier without one was intriguing, to say the least.

There was just one problem: the amplifier in question wouldn't work; being — I gather — chronically unstable! Apparently, it had been lashed up in the aforesaid lab, without due attention to the power supply, having been connected instead to a benchtop lab supply with near zero internal resistance. Vic's team managed to sort out the problem, but the end result was still so expensive that only a few 'well heeled' enthusiasts could ever afford one. However, while MBH valve preamplifiers and amplifiers were listed in sales literature, they do not appear to have figured large in the factory throughput. The one thing certain is that they were styled in the Vic Harris fashion: neat but never pretentious, essential functions only, and with MBH cabling and connectors.

The mid 1960s saw a changeover to solid-state electronics in lieu of valves. Like many others, Vic had reservations at first about the possible effect on performance, becoming convinced later that quality was basically a matter of proper design.

More to the point, solid-state technology made it possible to house a complete high quality system in a cabinet formerly occupied by a control unit.

The Saraband system

From the late 1960s, private hifi enthusiasts were encouraged to consider the 'Saraband' ready-to-play unit, said to be 'free of gimmicks' and (I paraphrase) combining in one integrated unit the fundamental simplicity and quality of MBH components, each perfectly matched to the other.

To hand as I write is a brochure describing a stereo model Saraband, undated but obviously from the solid-state stereo era. It comprised a belt-driven turntable and stereo magnetic pickup, a stereo amplifier and control panel, housed in a free-standing, polished wooden case with a lift-up perspex lid.

Apparent options included a 12", or larger, Equidyne pressed aluminium arm, with anti-resonance felt pads and fitted with a quick-release head socket.



Fig.6: A solid state Saraband amplifier/record player. Produced around 1989, and intended for record collectors, it is fitted with a precision multi-speed turntable capable of playing 33/45/78/80rpm discs. It is provided with Equidyne arm, raise/lower lever and provision for interchangeable heads.

The arm also featured anti-skating compensation and a fluid damped vertical bearing.

The Saraband was normally fitted with an MBH stereo head, -L or later, set up ex-factory with a playing weight of 1.5gm or, if preferred 3.0gm, thereby offering an extra degree of ruggedness for slightly increased stylus wear. An 'Easycue' lever fitted near the front of the motorboard allowed the pickup to be raised clear of the record and lowered again, without fuss, into the same groove.

The belt-drive turntable motor was said to be the end product of four years of research, aimed at achieving performance figures equal to those of MBH professional models and considered appropriate for stereo replay. It provided for 33rpm only, on the grounds that the provision of other speeds could compromise the simplicity and performance to little real purpose.

(This decision was revised later when clients began requesting facilities to play their vintage 78s, etc.)

The S4002 amplifier fitted to the Saraband under discussion was one of the S4000 series of solid-state amplifiers which were accepted as appropriate for release in 1968. It had a power bandwidth from 25Hz to 100kHz of 20 watts per channel, with both channels driven in phase into 12-ohm loads. The THD was around 0.1%. The pickup input sensitivity was quoted as 3mV, RIAA compensated.

In a letter to hand from Ross Sheard, one of Vic's advisers, he says that the early Saraband amplifiers were assembled using Veroboard and, as such, did not lend themselves to quantity production. It fell to his lot to convince Vic that the amplifiers could be redesigned to advantage using IC's and conventional printed circuit boards — an area where Ross had gained considerable experience.

Vic apparently took a deal of convincing, not because he disagreed with the advice but because of 'a natural reluctance to change'.

All told, however, the concept of the Saraband added up to conservative hifi common sense, with none of the 'smoke and mirrors' exaggeration that has characterised the offerings of some ostensibly golden-eared hifi entrepreneurs.

Loudspeakers

As far as loudspeakers were concerned, Vic was said to have been partial to the once popular Barker Duode — 8" and 12" — which he initially imported direct from the UK for use in Australian-made enclosures. Later he began to assemble them from imported components and ended up importing only the 'soft' components and using locally produced frames and magnetic

systems. It is reasonable to suppose that Vic was making good use of the skills he had picked up as a production foreman at Magnavox Australia.

To hand is a brochure entitled 'MBH Loudspeaker Systems', as available from MBH Audio Sales, Homebush West. No loudspeaker driver brand names are mentioned, the inference being that MBH custom-built systems involved selected loudspeakers in an array of stoutly built enclosures and fitted with an exceptionally good — if expensive — divider network. Contemporary options included large free-standing enclosures, smaller enclosures with metal stands, panel systems to build into walls or partitions, and three tall, slim corner enclosures measuring 175, 142 and 122cm tall and from 45 to 55cm wide.

At this remote point in time the brochure reads as a rather routine document, seemingly proceeding on the assumption that if a loudspeaker system carries the MBH logo, it must be good! To me it lacked the conviction and the fervour of other MBH literature. Maybe Vic okayed it on an off day!

Trouble loomed

Unfortunately for Vic, there were clouds on the distant horizon which spelt more trouble for him than he could possibly have foresee.

First off, planning for a new City-West expressway and feeder roads had long since threatened to absorb the land on which the relatively new MBH factory stood. According to the RTA — or was it the DMR in those days — the site was to be resumed and one day in the foreseeable future, the bulldozers would move in to clear the way for a new road.

Vic was understandably dismayed, and began to work out what he might do about it. A site adjacent to a rail facility seemed like a good idea, but nothing suitable was forthcoming. At the other extreme, he began to think in terms of a workshop/dwelling in the Manly-Warringah area; but again, without result. Fifteen odd years later, the worst still had not happened and Vic soldiered on in the fervent hope that the road project would be delayed still further by political argument.

In the same period, I gather, Vic had staff problems arising from accident and/or sickness. Production fell behind schedule, and the arrangement with All-India Radio lapsed. Under the strain, Vic's own health faltered.

As a result when the final notice did arrive, Vic was not able to execute the move in the way he would have preferred. The contents of the factory were to have been systematically transferred into cases and cartons, each numbered and with their contents carefully documented.

Instead, as it turned out, it became a race to get the contents out before the bulldozers pushed the walls in. Indeed, it was even worse than that!

Peter Stinson was involved because, over the years, he had built up a close relationship with Vic Harris. Interested in hifi since his school days, Peter had subsequently stumbled across the MBH brand name and progressively inherited several old pickups — HH and MBH B type, etc — and a couple of old valve amplifiers.

Vic was vastly intrigued when Peter turned up at the factory with first one, and then others. Instead of politely dismissing his inquisitive young visitor, he took time off on each occasion to tell him about 'the old days' and help restore his treasured acquisitions to working order.

Ross Sheard tells how, in the 1960s, he (Ross) had set up his own disc recording studio but ran into strife when the drive/feedback windings in his Westrex disc cutter were accidentally burnt out. He searched Australia in vain for someone who could help him out, until Vic Harris finally volunteered to 'have a go'!

With infinite patience, Vic removed the burnt-out windings and replaced them by hand, the feedback winding in particular involving wire that was difficult enough to see, let alone handle. The restored head worked as well as new.

Some time later, Vic agreed to let Ross Sheard set up a couple of disc record presses in an annex — 'the shed' — at the rear of the Flemington factory. In the context of MBH it was massive equipment involving steam heating, screw-type extruders and pressures up to

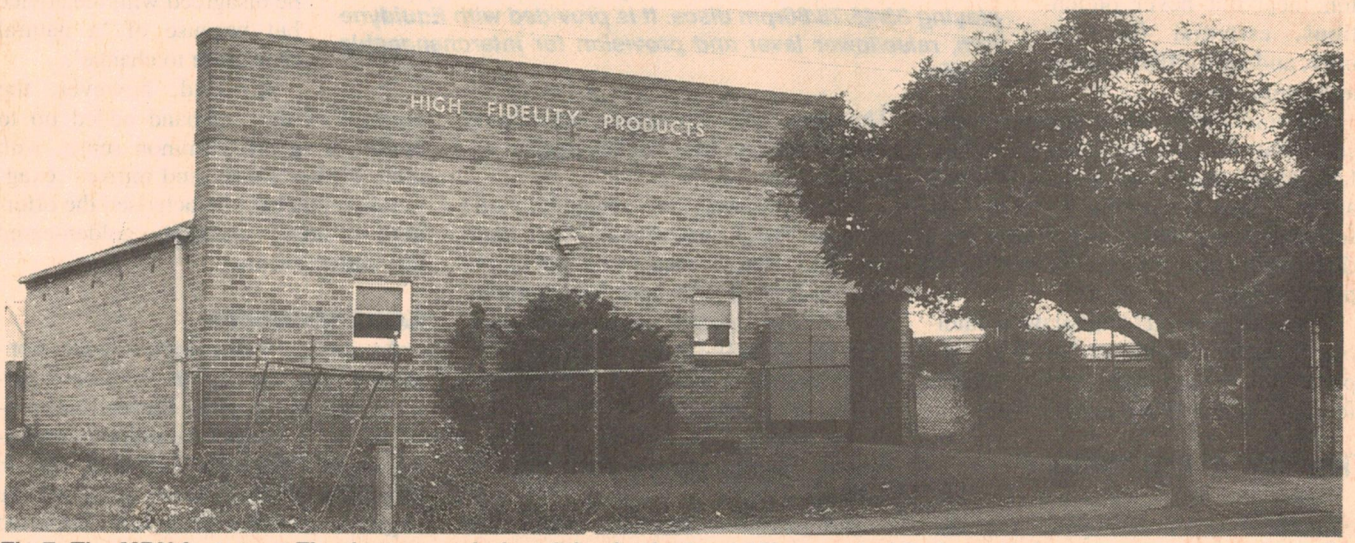


Fig.7: The MBH factory at Flemington, an industrial suburb about 10km west of Sydney. Unfortunately, it occupied a site earmarked for an access road. Not visible here, an annex at the rear housed a record pressing plant operated by Ross Sheard.

3000psi; but, says Ross, Vic took the same intelligent interest in the equipment as he had in the micro-engineering required to build pickups.

Over the following years a million-odd pressings were produced under contract in the Ross Sheard annex, and the two men took considerable interest in each other's activities. And that, I gather, was Vic's style — and the reason for the immense amount of goodwill that was evident amongst the hifi enthusiasts who had dealings with him.

It was also the reason for Richard Dibbs' remark quoted last month, that Vic was too much the obliging (analog disc) enthusiast ever to make a lot of money (for himself) out of his chosen career!

When the time came to move there was no lack of concern for Vic's welfare, but no-one could have anticipated the shattering course of events.

As Peter Stinson tells it, as the ground for the new road was progessively cleared, the HiFi Products factory was just about the last building to go, "standing forlornly in a wasteland of debris".

It was too much a temptation for vandals, who broke in one night in search of anything they could 'flog'. Instead, as they ransacked the shelves and cupboards, they found mainly jigs and dies and (to them) useless tools and instruments.

The filing cabinets were full of equally useless papers, so they piled the papers in a heap and set fire to them.

Utter chaos

Morning revealed a scene of utter chaos. The combustible contents of the factory had burnt, the roof had partially collapsed and much of the front brick facade was a pile of rubble. Buried amongst the bricks and the ashes were the remnants of what had once been a specialist hifi equipment factory.

Vic was in a virtual state of shock, but a number of members of the Phonograph Society rallied to help collect and sort the smaller items while others tackled and transported the heavier items like lathes into 'storage' — which usually meant the Harris family garage at Beecroft.

Vic gradually sorted himself and while hindered by the loss of his engraving and injection moulding facilities, he was able to assemble the occasional record player system, and to undertake essential repairs to pickups, loudspeakers and amplifiers. It certainly kept his former customers happy and, at his age — 70-plus years — Vic seemed content to work at that level.

Around 1994, he bought a house in Balgowlah, in the Manly area, sold the home at Beecroft, and set about transferring his technical equipment to the new site.

It proved to be a major project, complicated by his wife's recurring health problems and the need for a fair amount of renovation to the property. Once again, help was forthcoming from the Phonograph Society but says Peter Stinson, just when he seemed to be gathering strength for a new phase of activity, he died.

Sad enough for his family, Vic's death was also a bitter blow to members of the Phonograph Society. To them he was a vital link with a mutually treasured, century-old technology which had quite suddenly been superseded.

Prior to his death, they had been grateful for his intention to provide technical maintenance for their MBH equipment. Apparently there had also been some discussion about sharing his techniques with some of their technically inclined members, against the day when he might no longer be able to carry on. But suddenly he was gone, along with his pre-disposition to mechanical precision relative to analog audio technology.

Which brings me back to where this story began. During the course of Vic's career, other generations of mathematically inclined engineers, developing computer technology, had come up with techniques for manipulating numbers with incredible speed and accuracy.

Quite suddenly — within the past couple of decades — the need to record the actual shape of an audio envelope had been obviated. Instead, its instantaneous value could be precisely measured at supersonic intervals and recorded on tape or compact disc as an ongoing sequence (torrent?) of encoded numbers (measurements) — the 'digital' technique.

In digital form, the signal could be checked, timed and copied as many times as necessary without loss of quality or build up of background noise. Nor, assuming the use of crystal-locked hardware, was there any risk of wow and flutter.

And, given the use of a sufficiently high sampling rate — e.g. 44kHz — and an adequate measurement range, the train of digits could/can be converted at any stage back to the original waveform with a potential response flat from the sub-bass range to over 20kHz, and a dynamic range and noise headroom of around 100dB. All of this without any audible artefacts.

In short, the digital system offers, as a matter of course, a standard of performance which the exponents of the all-analog system could only dream about. My guess is that Vic Harris passed on, not bitter but knowing that in his time, he had helped push the analog system to its commendable limits! ❖

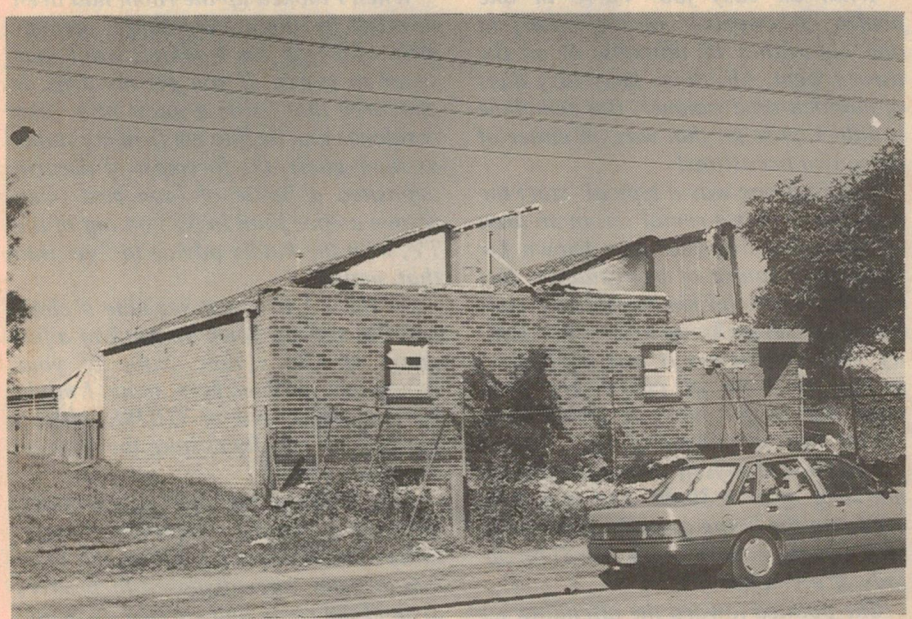


Fig.8: A sad sequel: the MBH factory, after it had been ransacked and set ablaze by vandals in mid 1990. Vic sought to re-establish his activities at a 'retirement' level, but time ran out for both Vic and his wife Mary.

THE SERVICEMAN

Customers — where WOULD we servicemen be without them?

Mobile servicing has always been more interesting than simply finding and fixing faults back at the workshop, because of the wide range of customers and situations you come across. Two of my stories this month come from a technician in Kiwi land, who describes a couple of service calls that are even more memorable than any I've every had myself. There's also an interesting story about resurrecting an old VCR found abandoned in the street, and yet another tale about tracking down an elusive intermittent.

I've often said that servicing would be a great job if it were not for the customers. (Only joking!) This month I'm opening the column with a story from a serviceman in New Zealand, about some really memorable customers.

The contribution comes from I. Matek, of Auckland. As you will see, his experience goes back a long, long way and the customers recorded here must have been pretty notable to have been remembered after all this time.

I first came across Mr Matek's story in the newsletter of the Electronic Technology Services Association (ETSA), the Kiwi equivalent of Australia's TESA. Their editor called for entertaining contributions from members, and Mr Matek's story was the first one used.

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READER INFO NO. 8

It was just too good a yarn to languish in a small circulation newsletter, so I asked if I could use it here for the amusement of a wider audience. Mr Matek and the Association were happy to share the story, so here is what he had to say...

Reading the intro for the new column in the ETSA Bulletin jogged my memory about a couple of incidents that happened to me when I was servicing some years ago. Both involved what should have been simple, straightforward house calls to replace a tired DY87 EHT rectifier — remember them? (They were known as the 1S2-A in Australia — Ed.)

What an easy job. Valve in one pocket, screwdriver in the other, in and out within 10 minutes; or so the theory went. Ah, those hazy lazy days of monochrome summer. But somehow it didn't quite go that way on either of these two occasions!

The first one was a typical 'start the day' job. It was a rental set, in an area of State Housing that was known for the robust nature of its residents. Not an area in which I harboured any aspirations to set up house and raise a family, but nonetheless it was home to a broad spectrum of characters from what we might now describe as a 'lower socio-economic group'.

I presented myself at the front door not long after 8:30am, and was ushered into the living area (lounge would be a serious misuse of the word) by the lady of the house.

She pointed toward the offending set and said "Got a hole in the middle of the picture!" She then disappeared stage left, where I heard her announce to someone that the fella was here to fix the telly...

I got on with the job and was removing the back when I became aware of a dull rumbling, like distant thunder, somewhere up above. It seemed to be coming my way.

By this time I was negotiating the new DY87 into its socket. For the benefit of you young blokes who think that all EHT rectifiers have wires attached and get bolted in, this could be a frustrating process. It could take forever if the base wasn't quite straight or the valve had a bent pin, because you couldn't see into the socket to line them up properly.

When I looked up the room had been invaded by three very large 'gentlemen' of a type you wouldn't want your sister to marry, if you get my drift. It appeared that I was a guest in a gang residence and as if to confirm my status as their guest, the foremost of the trio deposited a bottle of Lion Red (well known amber fluid in NZ) on top of the TV, with the kindly advice to "get into that, mate!"

So there I was, not yet nine o'clock and I'm staring down the neck of a full quart of Lion's best. None of your nancy-boy stubbies here, mate. I might have managed one of THOSE without too much difficulty despite the hour — but a full quart?

I considered my options carefully, but leaving without sampling the hospitality of mine hosts did not appear to be one of them. They disposed themselves around the room and carried on drinking while they watched me work.

I took a preliminary swig to get things under way, and this earned

grunts of approval that confirmed that I was not going to escape without making a serious dent in the contents of my personal bottle...

Well! It turned into the second longest job time ever recorded for the changing of a DY87, and probably wouldn't have taken much longer if I had decided to remove and replace the back screws with my teeth!

I kept myself occupied behind the set pretending to work, and took another drink every now and then whenever I could face the bottle. They had the best adjusted set in the district by the time I finished. My audience stayed for the entire performance, dashing my hopes for a speedy exit if their interest had waned and they decided to leave the room.

When I finally left, I was cordially seen off the premises and headed straight back to the workshop, which was mercifully close. There was no way I could continue with my calls smelling like a brewery and besides, not being much of a beer drinker at the best of times, all I felt like doing was going back to bed.

On the positive side, my colleagues saw the joke and I think I passed the test — though I never received my 'patch'. I still wouldn't want my sister to marry one, but the mother-in-law? Well, that's a different question.

The second of my trials came at the end of a long hot day, and must surely qualify as the longest service call ever for the replacement of one simple DY87. I had finished my last job for the day and was on my way home, having signed off on the RT (radiotelephone) when I was called back by the operator.

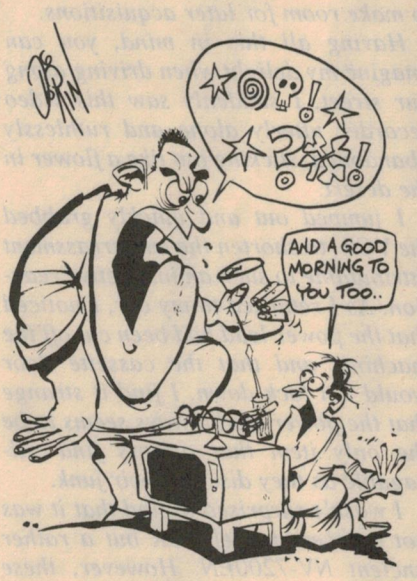
She had the local manager of a major rental company on the phone, and he in turn had a very irate customer on another line demanding service — which the rental company had promised for that morning, but forgotten to pass on to us.

The operator wanted to know if I would make the call or whether the rental company manager should take out a loan set, something I gathered he was loathe to do due to the state of mind of his customer. I said I would do the job, but whether I could repair the set or not depended on the fault. She said that the complaint was a hole in the middle of the picture, so knowing that a DY87 was probably all that I would need, I accepted the details. I told her to tell the manager to advise his customer that I was on the way, and would be there inside of 10 minutes.

The address was in an area of Government housing for military personnel which does not look a lot different to the usual run of State houses — just a little less cared for due to the short term nature of military postings.

I walked up the path and knocked at the door, which was promptly opened by a fellow twice the size of the trio in my previous experience, and he was three times as mean!

He greeted me with a barrage of creative language which cast aspersions on my parents and all those who had gone before them, the gist of which seemed to be suggesting that my father had never married nor his father before him. As a consequence of their alleged unwed status, he also seemed to believe that I would go unmissed and unla-



mented if I were never to be seen again.

From all of this and from the very real threats of physical violence he was making, I deduced that I had been played for a sucker and the rental manager had told his customer that the failure to supply service was the fault of the useless service agent he was forced to use and not due to any shortcomings at his end of the organisation.

As I represented the nearest target that could be identified, I copped the lot! Had it not been for the intervention of his wife, who reminded him why I was there, I might have been in real trouble. Some swift talking got his priorities sorted so that death and/or dismemberment were postponed, at least until repairs to the TV were completed.

Taking advantage of this lull in hostilities, I got behind the set and started the repair. As I did so, I put on my best set-side manner (usually reserved for my more attractive customers — I was single in those days) and following the old rule that people love to talk about themselves, I asked a few questions about life in the Forces.

The responses were slow at first, but speeded up as he warmed to his subject; before I knew it we were chatting away like old friends. Actually, chatting is an exaggeration. In reality I was listening away like an old friend with only the odd response required to keep him on the boil.

When I pronounced the job finished he seemed genuinely surprised and graciously expressed his satisfaction with the services rendered. You could have knocked me down with a feather, considering that not 20 minutes earlier he had been wanting to knock me down with something a great deal heavier than that!

What followed was even less believable. It was now about 6:30pm and as I packed up my tool kit, I commented that this was my last job for the day.

"Well, you'll stop and have a beer before you go then?" he asked, and, not wishing to shatter our fragile friendship, I accepted his offer. One beer led to another as they so often do, and when I tactfully said that my capacity for that beverage was limited, he offered a whisky instead.

I was doomed! He had found my only weakness! The invitation to stay for tea was a mere formality and we carried on as great mates till after 10. If only I could have claimed the overtime!

Finally I had to leave, while I was still in a fit state to drive. Then came the most extraordinary moment of all. As I got up to go he cleared his throat a couple of times then said "Listen, I was a little hasty when you got here, and I said a few things in the heat of the moment that I shouldn't have. It wasn't your fault, and I'm sorry if I came on a bit strong".

What could I say? I mumbled that it hadn't been that bad, thanked him for the meal, drinks and conversation and headed for the door. His wife, long suffering woman that she was, saw me to the door. When we were out of earshot of her husband, she turned to me and said "I don't know what you've done to him! He's never apologised to anybody in the 20 years we've been married. Now I've heard everything".

And so ended the longest DY87 replacement in history!

Well, what can I say after that lot?

the door. When we were out of earshot of her husband, she turned to me and said "I don't know what you've done to him! He's never apologised to anybody in the 20 years we've been married. Now I've heard everything".

And so ended the longest DY87 replacement in history!

Well, what can I say after that lot? I've had some crazies among my customers, but I can't recall any that threatened me with actual physical violence. Mr Matek is to be congratulated on the tactful way he handled the situations. And I agree that a quart of lager before 9.00am would send most responsible servicemen back to bed for the day.

Thanks, Mr Matek. We'll look forward to more stories from you or your Kiwi colleagues.

Resurrecting a VCR

Now we come to a more conventional Serviceman story, sent in by another new contributor, Tony Sippl of Woodlands in WA. It seems that Tony is my kind of man — can't resist helping the council with it's annual clean-up. I've lost count of the number of radios, record players and TVs I've salvaged from the tip — before they got there, that is!

Most of my collection has ended up as spare parts, but some have been resurrected like the prize that Tony tells us about here:

The annual cleanup, which is one of the services our council provides, is an important event. Approaching this day you find many unusual activities going on in and around back yards. On the otherwise thoroughly groomed lawns of our shire strips, suddenly you find piled up all kind of things, ranging from garden waste to bulky furniture. It is interesting indeed to see what some people find worthless.



Some of them are probably a bit like me. I suffer a bleeding heart as I part with things that will no longer fit into the overcrowded garden shed. In fact, I am one of those people who find that the odd things abandoned by less possessive persons are still worth picking up and storing in the aforesaid shed, until in turn they must be abandonned to make room for later acquisitions.

Having all this in mind, you can imagine my delight when driving along our street, I suddenly saw this video recorder utterly alone and ruthlessly abandoned, sticking out like a flower in the desert.

I jumped out and quickly grabbed the VCR, to shorten the embarrassment attributable to such an instinctive reaction. As I returned to my car, I noticed that the power lead had been cut off the machine, and that the cassette door would not lock down. I find it strange that the power lead always seems to be the only item that owners find salvagable as they discard their junk.

I wasn't surprised to find that it was not a recent model VCR but a rather ancient NV-7200EN. However, these old machines are often more reliable that newer ones and this one had a two week, four programme timer. Unfortunately, the remote control had not been dumped with the machine, but in all other respects it looked like a useful win.

Now, I'm not a professional radio and TV man but having worked for 25 years in industrial electronics, I have a crude knowledge of VCRs and I find no end of pleasure in fixing them. This is especially so when working on my own gear, as I have all the time in the world and nobody is pestering me to get the job finished.

The NV7200 came with at least one obvious defect: the cassette door lock was not working; and you're right if you suspect that there was more trouble hiding. In fact, I could see marks on and around the door where somebody,



most probably wanting desperately to return a tape to the video shop, had successfully forced the door. However, the major parts of the cassette carrier are a very solid and robust construction and so remained undamaged.

After I had replaced the power lead, and checked for obvious shorts or other troubles, I switched on and was greeted with about four seconds of whirring noise and then nothing. There was no sign of any action, no matter which key I pressed. I removed the top cover and checked for blown fuses etc., but this revealed nothing. Neither did an examination of the power rails — both 5V and 12V were present and steady.

I took off all the covers and was surprised by the number of PCBs and the generally good engineering put into this poor old fellow. The large base PCB was held in a metal frame and flipped up to reveal the most intimate moving parts in a most convenient way.

While switching the power on and off to see what was causing the whirring noise, I found that one of the four motors was driving two belts and a pair of pulley wheels. The larger of the two wheels was supposed to drive all kinds of levers and switches, but it was just sitting there, doing nothing.

The big wheel carried a notice, in large red letters, to the effect that one should not, under any circumstances, move the wheel by hand. It didn't say why, but perhaps it breaks the cassette door lock??!

I hunted for the cassette door catch, since I was growing tired of holding the door closed while investigating other parts of the mechanism. Eventually I found a small plastic hook surrounded by a complicated lock and release mechanism.

At first the hook looked to be intact, but when I touched it, it proved to be broken and just holding together with a thin bridge of plastic.

Now that there was nothing left to break, I felt that I should go for it and turn that magic wheel by hand.I switched the machine on, to see which way the large wheel should rotate during loading, then decided to help it on its way a little with a gentle finger pressure.

Then wonder of wonders, the unconscious machine suddenly came to life and proceeded to load in the normal way. I continued to help the wheel until the loading arms completed their travel, after which the machine was to all intents perfect. Clearly, it was the two belts that were slipping, due probably to having stretched over the years. Unfortunately, this all happened late on Friday and I was too impatient to wait until Monday to obtain a new set of belts. I resolved to effect a repair by snipping a short length out of them and rejoining the ends with Super Glue.

I knew of the Super Glue trick since I had once worked for a firm that sold expensive digital tape recorders and we had used this procedure to accommodate more powerful motors in brand new equipment. The rejigged belts lasted well past the warranty period, and probably as long as any unmodified belt. So I had no hesitation in using it on the old NV-7200.

All that was left to do was to find some way to latch the cassette door and keep it closed. In the end, I repaired the plastic catch by tailoring a shim brass bandage to align the pieces, and then securing them with two small screws.

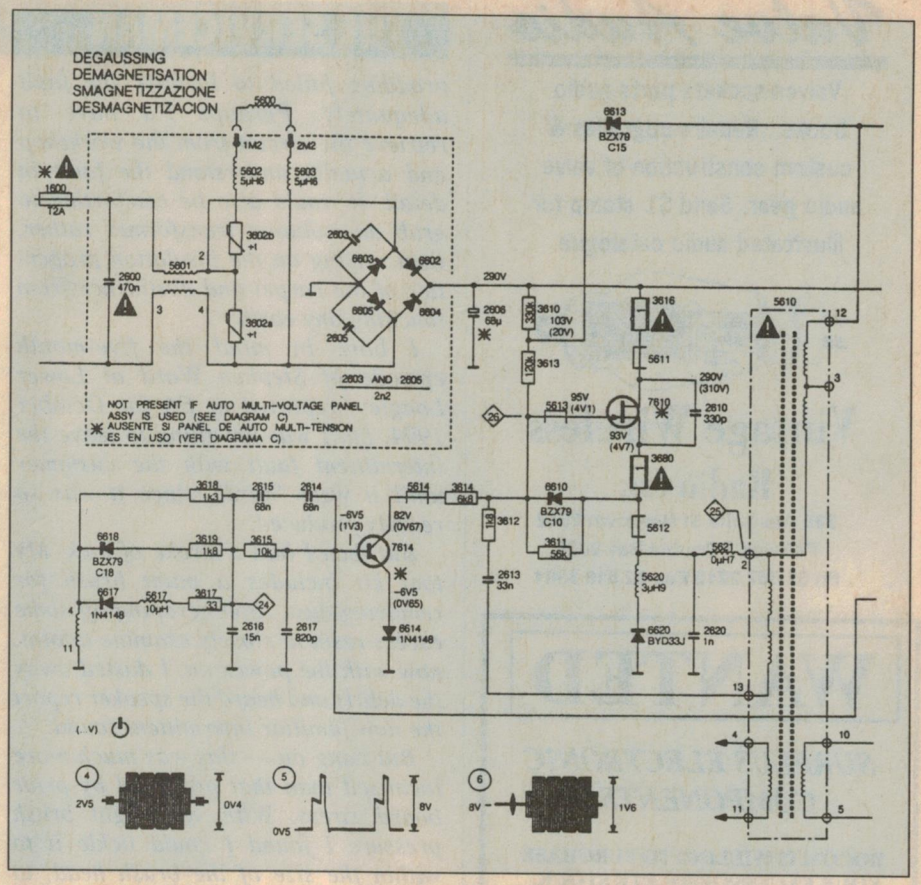
Both the belts and the cassette door catch are working well to this day.

The only disappointment with this job was that I didn't have the nerve to visit the 'dumper' of this machine and ask for the remote control. It's probably lying around his house, getting in the way but otherwise doing nothing. But then, one doesn't do that kind of thing, does one?

I agree, Tony. I wouldn't ask either, but some I know of would be cheeky enough to ask for the remote control AND the User Manual!

Those of us well acquainted with servicing older VCRs would have twigged to the belt problem earlier than you did. It's a common trouble. However, the symptoms vary so widely, even in the same model, that we learn something new every time the story is told.

Thanks for your contribution, Tony. Perhaps your fee for telling the story will buy you a new remote control.



A power supply diagram for a Philips GR1-AX television. An odd feature of the diagram is that a test voltage is given for the MOSFET gate, despite Mr Smith's assertion that to do so results in the destruction of the device!

Elusive intermittent

Now we come to our last contributor for the month, and it's Graham Smith — who also featured in these pages last month. Graham is from Lindfield in NSW and he tells the story of a manufacturing defect that should never have happened.

The customer had been overseas for two weeks and returned to find their TV sound totally lost soon after turn on.

This was a Philips 20GR1055, GR1-AX chassis which I had serviced three months earlier, after horizontal output failure. The sound output proved sensitive to board pressure, thus either a board fracture or dry joint was indicated.

This is a single board chassis and although a little flimsy, light passing through the board did not evidence any shadow from a fracture. Two hours of

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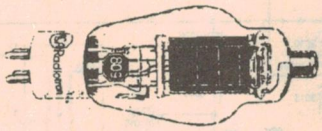
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THE SERVICEMAN

prodding failed to localise the fault adequately. Perhaps I'd have to retrieve the circuit from the workshop and actually understand the fault in detail. It would also be comforting to grab an isolation transformer rather, than relying on the insulation properties of the carpet and abstinence from touching any earth!

I bore in mind the five-month episode of Stephen Ward at Lower Longley, reported in EA for October 1994, but I was unwilling to leave the intermittent fault with the customer until it went 'hard', since it was so readily produced.

But then I had a stroke of luck. My tool kit includes a paint brush for removing dust. After scraping off some excess resin to closely examine a joint, now with the power on, I dusted away the debris and heard the speaker report the now familiar intermittent sound.

But hang on — this was much more localised than that produced by prior board stress. With very light brush pressure I found I could tickle it to within the size of the brush head, to produce the symptoms.

Then it was clear as to what was happening. I focussed on what was likely a post-manufacturing modification: a 15mm wire bridge on the copper side. With a tug, the link wire pulled off at right angles from the board — and there was no trace of solder on it!

The joint was relying on a very limited surface area due to the right angle intersection with the pad. The link was scraped, tinned, bent flush with the pad and soldered. An hour to find it and 10 seconds to fix it. What a way to spend one's days!

Now a word of caution: I took some care not to brush the board near the power supply MOSFET, having experienced its extreme sensitivity during the last episode. Experience is certainly instructive.

The depressing statute dictated by Horner's Five-Thumb Postulate tells: 'Experience varies directly with equipment ruined'. Keep well away from Philips power supply MOSFET gates. No measure! No lookey! The slightest touch gives rise to BANG! Owww! (I wonder what the arabic note in that vicinity of the circuit diagram actually advises?)

I'm sorry, Graham. I can't tell you what the note says because my copy of the circuit does not carry any arabic inscriptions. On my diagram the note is written in Chinese and says 'Do Not Measure Here!'

Seriously, though, thanks for the warning! I don't know if I have ever had reason to test at that point but your alert may well prevent an expensive accident in the future.

And that's it for this month. My typing fingers have recovered some of their agility, so I'll spend the next four weeks entering some more of your contributions. Until then, Bye! ❖

EA'S READER INFORMATION SERVICE BBS

As part of its service to readers, *Electronics Australia* now operates a Reader Information Service Bulletin Board System (BBS). This makes available a wide range of useful information, for convenient access and rapid downloading by readers equipped with a personal computer and modem.

Here's an idea of what's currently available on the BBS:

- Software needed for recent PC-based EA construction projects
- Index files for EA and ETI projects
- Recent notes and errata, both published and as-yet unpublished
- Useful public domain and 'shareware' software for electronics and amateur radio
- General interest shareware utilities, such as the commonly-used compression and decompression utilities.
- The ability to upload Letters to the Editor, and/or contributions to our Forum and Information Centre columns (send them as plain-text ASCII files, please!)
- An on-line 'Discussion Forum' facility, allowing readers to exchange useful technical information directly.

The BBS is ANSI-compatible and is currently operational for virtually 24 hours each day, seven days a week, on (02) 353 0627. Your modem can be set to any standard speed from 300 to 28,800b/s full duplex, with a data format of '8-N-1' (eight data bits, no parity and one stop bit).

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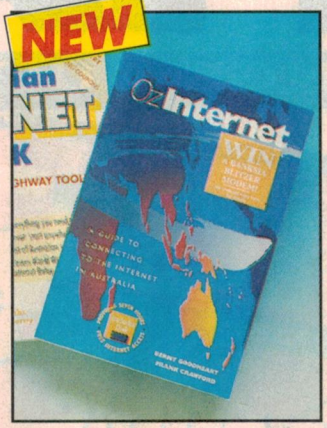
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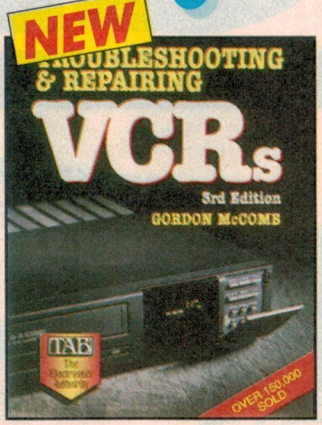


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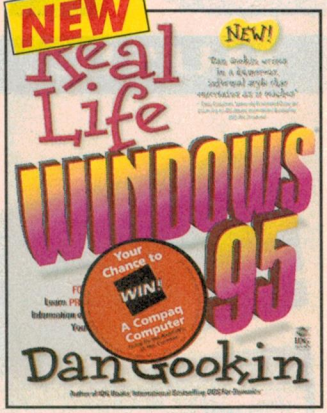


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EA Nov '95

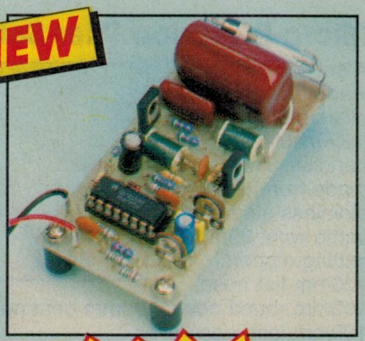
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NEW

Compact and inexpensive to run, this Xenon flashing light makes a handy flasher or hazard lamp. Great as an emergency beacon, strobe for parties or just something to impress your friends. For an even brighter light, an optional torch reflector can be used. Operated via a battery or DC plugpack, it has reversed power supply polarity protection. (Plug pack or battery not supplied.) Comes complete with all components PCB & hardware.

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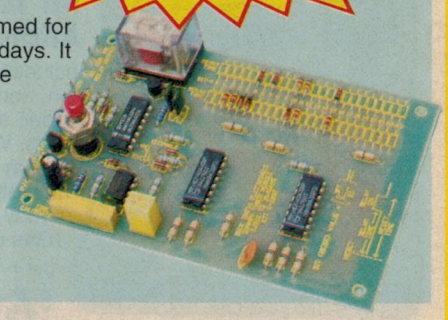
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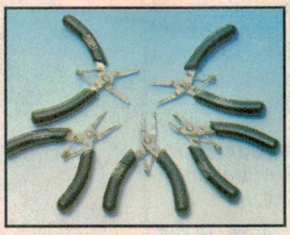
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Silicon Chip Mar '89

Availability: Our kits consist of many different parts from numerous suppliers. Whilst we have consulted closely with them and are satisfied with their ability to supply, sometimes problems can arise in obtaining all of the parts. This means there is a slight chance that availability may be delayed. Rainchecks are available, however, if you'd like to check beforehand, don't hesitate to contact your local store.

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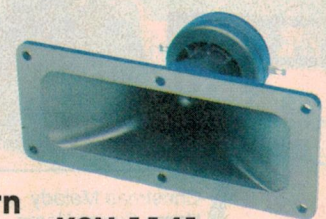
Cat C-2205 **$17.95**



KSN 1038 Horn Tweeter

Frequency Response: 4kHz to 27kHz
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Maximum Power Handling: 75W (8 Ohm system reference)

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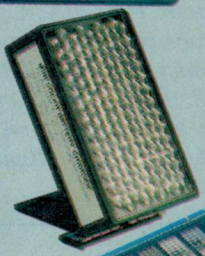


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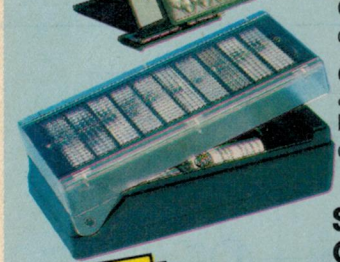
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B 2151

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

Simple computer interface

I often repair irrigation timers, and needed an easy way to check their operation. This simple interface circuit uses the games port of an IBM compatible computer to monitor two input lines. When a logic high (5-18 volts) is applied to the base of transistor Q1, via R5 and D2, pin 2 of the games port (which is normally held high by an internal resistor) is pulled low by Q1 and R3. This condition can be recognised by the STRIG (1) command in QBASIC or similar.

The second channel involving Q2 functions in a similar way, being read by STRIG (5). Note that four channels are possible if your computer has a decent games port (use pins 10 and 14). To monitor the presence of 24 volts AC, and apply it to the bridge rectifier. The optocoupler will ensure that the computer is fully floating from the input.

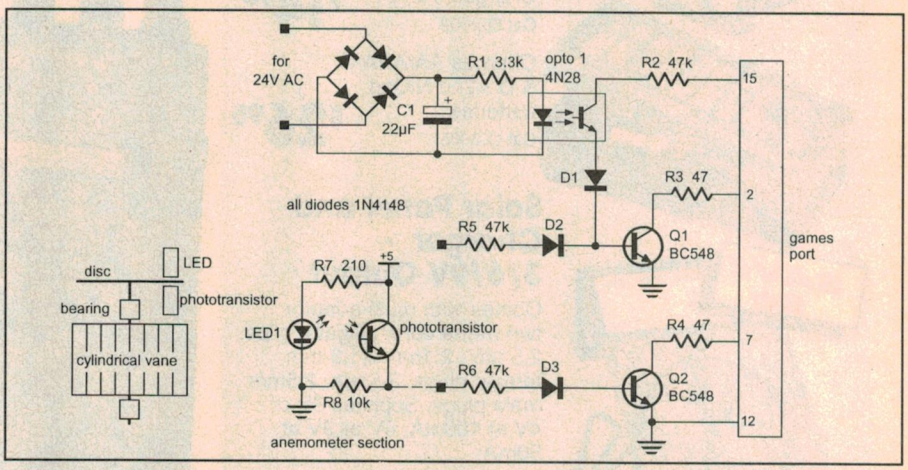
I have included some simple programs (written in QBASIC) which allow you to record the time at which an output switches, how long it is high/low for, to print this data (useful as a report for the customer), and to provide a visual output over 24 hours using colour bars (VGA screen).

You can also use the inputs as a low speed oscilloscope (for digital signals only) with a resolution of better than 10ms.

I also built a simple anemometer that gives a very simple yet comprehensive way to record wind speed. A small cylindrical blower serves as the rotor, and as it is mounted vertically, it receives wind from any direction. When the blower rotates, the disc mounted on the end of the shaft cuts the path of the light between the LED and the phototransistor. This is recognised by the software, and the number of pulses is converted to the windspeed. I have written some simple software in BASIC that calculates the wind speed and presents it in a neat, graphical format. I can post a copy of this and the other programs within Australia for $10 + $2 postage.

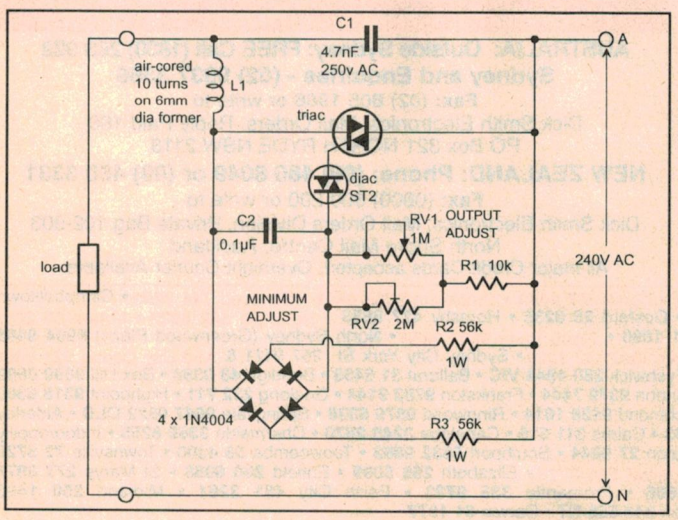
Leon Miguel
Hope Valley **$45**

(Editor's note: The QBASIC software for the interface circuit can be obtained from our Reader Service bulletin board on (02) 353 0627. The anemometer software can be obtained directly from Leon Miguel, Lot 1 San Miguel Road, Hope Valley, 6167.)



Inductive load controller

This circuit is a simple phase controller for inductive loads. It has been used for many years on a welder, with no problems, although it can be used with any inductive load. The type of triac depends on the power taken by the load.



Note that C1 is a 250V AC rated capacitor. Also, if RV1 is mounted on a metal front panel or in a metal case, make sure it's well insulated from the metal, as it connects almost directly to the 240V active. Use a pot with a plastic shaft, and mount the pot so no part of it is in electrical contact with the metal panel.

The triac must also be isolated from any metal enclosure. In most cases, a heatsink will be needed for the triac, and bear in mind that the tab of most triacs is connected to the terminal that goes to the 240V active. Power to the load is controlled by RV1, and RV2 sets the minimum power. The inductor is formed by winding 10 turns of heavy gauge insulated winding wire around an air-cored 6mm diameter former.

The full load current flows through this inductor. Resistors R2 and R3 are both 1W types. Capacitor C2 doesn't need to be mains rated, but use one with a rating of at least 250V DC.

J. O'Neill,
Blackheath, NSW. **$40**

Multi-flash adaptor for cameras

This circuit will enable photographers to use several flash units together, without overloading the flash contacts in the camera.

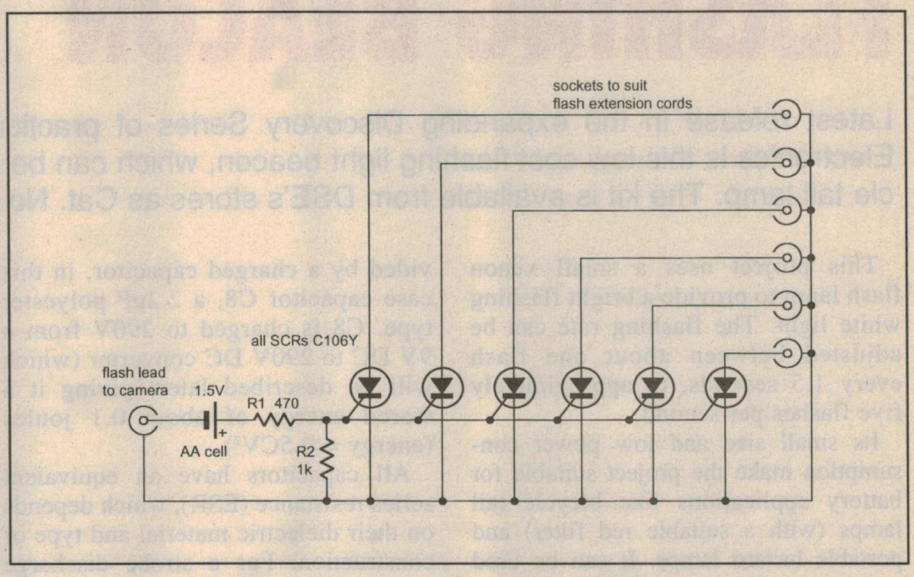
Commercial multi-flash adaptors merely parallel all the sync cords from up to three flash units, and send all the triggering currents through the camera. They cannot be used with a mixture of flash units which use a high voltage trigger circuit and newer flash guns which use low voltage triggering. This circuit, which was built for up to six flash units, operates with both low and high voltage trigger circuits, as each flash is fired by a separate SCR.

The circuit operates from a single AA cell. The sockets for the sync cords from the various flash guns can be obtained from old cameras, repairers, or as new spare parts from camera suppliers.

However, in making up the flash extension leads you could use any readily available plugs and sockets, bearing in mind that trigger voltages run up to about 270 volts.

In attaching the flash lead which goes to the camera, it should be noted that some of the sync cords which use shielded cable do not connect the shield to the 'outer' of the plug which goes into the camera. It's important that the 'outer' of the plug is connected to all the SCR cathodes, not battery negative. The prototype was built on a piece of stripboard and fitted into a small metal cylinder.

A.J. Lowe,
Bardon, Qld **$35**



24V-12V converter for trailers

I own a 1981 4WD which has a 24V system. Before I got involved in electronics, I had to change all the 12V globes in my camper trailer to 24V types for towing, but this is not usually possible with rental trailers or the like. This 24-12V converter overcomes the problem.

The converter consists of five identical modules built on a common board. Each is powered only when its light is switched on. The heart of each module is a 150Hz square wave oscillator, built around an op-amp. Op-amps were chosen for their 36V supply voltage rating, fast switching and low output impedance, which is needed to switch the power MOSFET.

On power up, capacitor C1 is discharged, holding the inverting input low. The non-inverting input (pin 3) is biased just above half the supply voltage by R1 and R2. As a result the output is high, switching the P-channel MOSFET off. Capacitor C1 charges via R3 and eventually the op-amp output switches low, turning on the MOSFET.

The low output of the op-amp pulls the non-inverting input just below half the supply voltage via R4, and C1 discharges through R3 and the output of the op-amp until its voltage falls below the lower threshold voltage at the non-inverting input.

The output goes high again and the cycle repeats. The on-off ratio is about 50%, so the average voltage seen by the lamps is 12V. Since power is transferred only half the time, the peak current is doubled, which averages to the normal current of a 12V lamp.

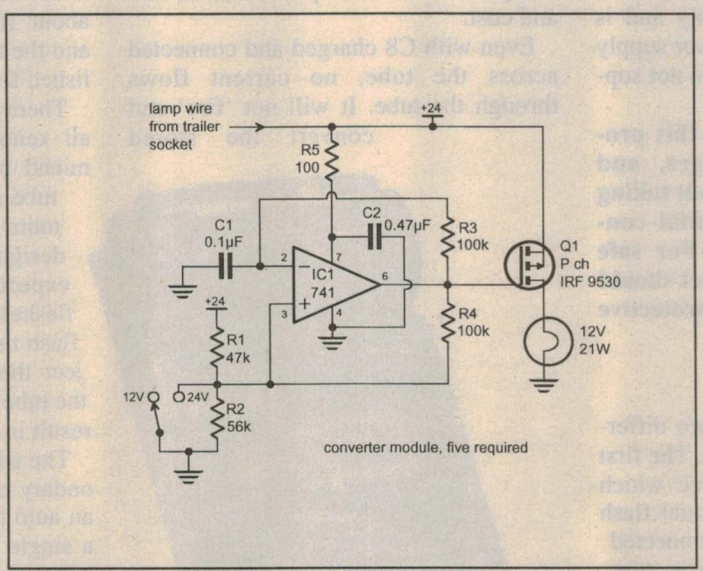
However check the existing wiring for excessive resistance, which can limit the peak current and reduce the brilliance of the lamps. The stop lights on a standard trailer have the highest power requirements (usually two x 21W lamps in parallel), so a MOSFET rated at 100W is needed. Two IRF9530s in parallel on a heatsink are suitable.

The converter can be bypassed via a five pole on-off switch, which when closed, ties all non-inverting inputs to ground so the op-amps stop oscillating and the lamps receive the full 24V.

Alternatively, five 12V relays that bypass each module could be used.

Note that this converter cannot be used with 12V DC equipment like a portable CD player. Use a linear 12V regulator instead. In some vehicles, the switching noise of the MOSFETs could affect radio reception.

Manfred Schmidt,
Edgewater, WA **$40**



DSE 'Discovery Series' Construction Project:

XENON TUBE FLASHING BEACON

Latest release in the expanding Discovery Series of practical learning kits from Dick Smith Electronics is this low cost flashing light beacon, which can be used as a hazard flasher or bicycle tail lamp. The kit is available from DSE's stores as Cat. No. K-2809, priced at $34.95.

This project uses a small xenon flash lamp to provide a bright flashing white light. The flashing rate can be adjusted between about one flash every 1.5 seconds, to approximately five flashes per second.

Its small size and low power consumption make the project suitable for battery applications like bicycle tail lamps (with a suitable red filter) and portable hazard lamps. It can be used without a reflector (not supplied), but a torch reflector can be used to produce a brighter more directional light. This would make it suitable as a demonstration 'strobe' unit to view rotating machinery, etc.

The project can be operated from a battery or DC plugpack supply and is protected against reversed power supply polarity. A case and battery are not supplied with the DSE kit.

Note that the circuitry in this project generates high voltages, and should not be operated without taking measures to prevent accidental contact by people or animals. For safe operation the complete project should normally be enclosed in a protective insulating case.

Operation

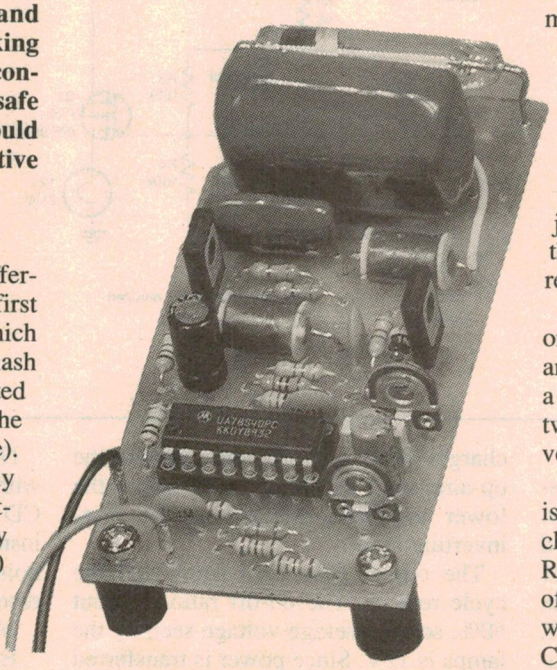
To operate the flash tube, two different power sources are required. The first is the high voltage DC source which supplies the energy for the actual flash of light, and this supply is connected between the anode and cathode (the electrodes at the two ends of the tube).

The characteristics of this supply are that it must have an unloaded output of 200V minimum (nominally 300V), and be able to supply 120 amps or so for a few microseconds into a near short circuit load. These requirements are conveniently provided by a charged capacitor, in this case capacitor C8, a 2.2uF polyester type. C8 is charged to 290V from a 9V DC to 290V DC converter (which will be described later) giving it a stored energy of about 0.1 joules (energy = $0.5CV^2$).

All capacitors have an equivalent series resistance (ESR), which depends on their dielectric material and type of construction. For a strobe discharge capacitor a small ESR is necessary so that most of the energy gets delivered to the tube and is not wasted as heat in the capacitor.

—charge capacitor type used in this circuit was found to be an acceptable compromise between performance, size and cost.

Even with C8 charged and connected across the tube, no current flows through the tube. It will not 'fire' and convert the stored energy into light, until a second *trigger* source is applied between the trigger electrode and the cathode. On the tube used in this project the trigger electrode is a film of metallic paint on the outside of the tube, with a wire wrapped around it to make contact.

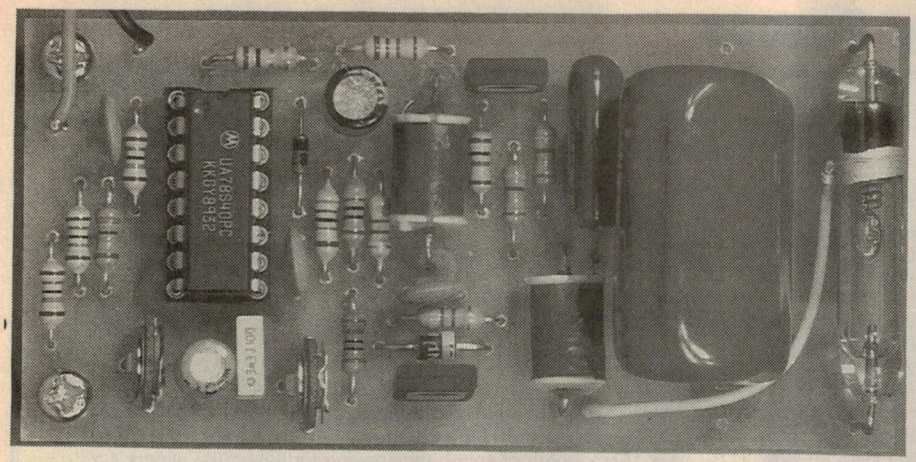


The required characteristics of the trigger source are that it must be a pulse of at least 4kV. But it only has to supply in the order of 1mJ (one millijoule) for less than a microsecond and the tube will fire. The trigger pulse starts a chain reaction of ionisation and light emission within the tube which results in a very high conductance between the anode and cathode. A heavy current flows from anode to cathode until C8 discharges to about 10V, then the tube switches off and the two sources have to be re-established for the next flash.

There is a limit to the operating life of all xenon flash tubes, which is determined by their power dissipation. The tube supplied for this kit has a maximum power rating of six watts and is designed for timing lights. Its life expectancy is specified as one million flashes for an energy input of 0.1J at a flash rate of 60 per second. In this project the average power dissipation of the tube is less than 0.5W, which should result in a much greater life expectancy.

The trigger pulse comes from the secondary of trigger transformer T1. T1 is an auto transformer, meaning that it has a single winding with a tap rather than two isolated windings, and it provides a voltage step-up ratio of 1:30.

The way the trigger pulse is generated is that with SCR Q2 off, capacitor C7 is charged from the 290V supply via R13, R14 and the primary of T1. A gate pulse of at least 200uA is then applied to Q2, which causes it to switch on and connect C7 directly across the primary of T1.



A close up view of the flashing beacon module, which can be used in conjunction with the PCB overlay diagram as a guide to wiring everything up.

The resulting 290V pulse is stepped up to about 8kV by T1 and triggers the flash tube.

The reason for not using a single resistor in place of R13 and R14 (or R8 and R9) is that the 1/4W metal film resistors used have a maximum voltage rating of 250V, whereas in those two positions the resistors must withstand 300V. The series connection gives them a total voltage rating of 500V.

The gate trigger pulse for Q2 comes from a square wave oscillator based around the spare op-amp in IC1. The frequency of this oscillator (Fo), and hence the flash rate, is determined by the values of C2, VR1 and R4 according to the formula:

$$Fo = 1/(2 * 0.693 * R * C2)$$

where R = R4 + VR1. With the values shown, the variable frequency range is from about 0.7Hz to 5Hz.

It is interesting to note that the polarity of the anode and trigger voltages applied to the flash tube with respect to the cathode are not critical, and that they can be reversed without any obvious difference in its operation.

The 9V to 290V DC converter is a flyback type that has most of its circuitry contained within IC1, which is a uA78S40 general purpose switchmode power supply controller. The 290V DC output comes from flyback pulses generated by L1, a 2.7mH inductor, which is switched on and off across the Vcc supply by Q1.

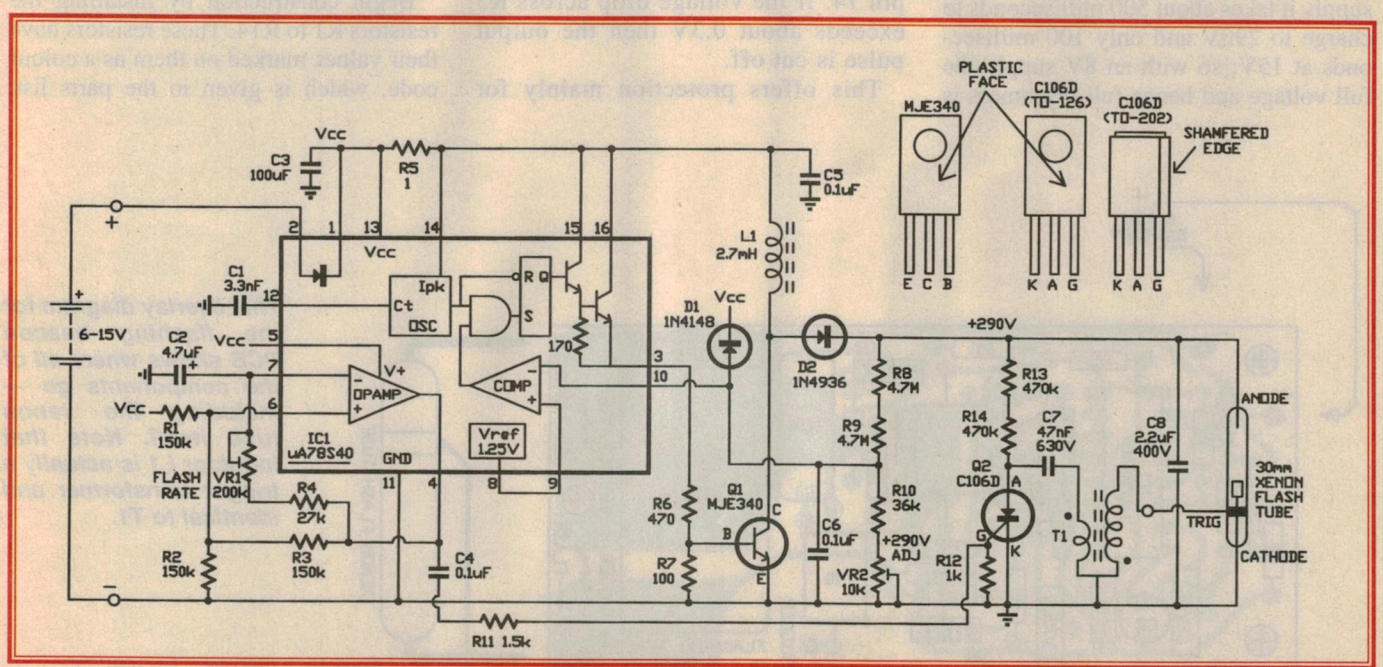
Q1 is switched on for 70us (microseconds), which allows the current through L1 to reach about 200mA. When Q1 is switched off, the collapsing magnetic field around L1 induces a voltage (called a flyback pulse) across L1, in an attempt to maintain the current that was interrupted. Because Q1 is switched off, the only path for this current is now through D2 to charge C8. Each flyback pulse adds some charge, and hence a voltage increase, to C8. The voltage across C8 would eventually increase to a point where components would be damaged if some limiting was not applied.

The component which is most likely to break down first is Q1, an MJE340 transistor, which has a maximum collector to base sustaining voltage (Vcbo) of 300V. A value of 290V was chosen for the high voltage source to ensure Q1 does not break down.

Voltage limiting is achieved here by sampling the high voltage via resistive divider R8, R9, R10 and VR1, and comparing it with a 1.25V reference that appears at pin 8 of IC1.

The use of trimpot VR1 instead of a fixed resistor is necessary because the tolerance of the reference voltage in IC1 (+/-5%), combined with resistor tolerances would have resulted in an unacceptable uncertainty in the value of the high voltage.

The voltage comparator in IC1 controls the width of the pulses from IC1 pin 3 to stop the voltage exceeding 290V. The pulse generator is within IC1



The schematic for the flashing beacon project. Most of the circuitry consists of a switch-mode DC to DC converter, stepping up the battery voltage to 290 volts to charge the capacitor C8.

Xenon Tube Flashing Beacon

PARTS LIST

Resistors
(1/4W 1% metal film unless otherwise stated)

		Colour Code 4 band	5 band
R1,2,3	150k	Brn-Grn-Yel-Brn	Brn-Grn-Blk-Org-Brn
R4	27k	Red-Vio-Org-Brn	Red-Vio-Blk-Red-Brn
R5	1Ω	1/4W 5% carbon:	Bro-Blk-Gld-Gld
R6	470	Yel-Vio-Brn-Brn	Yel-Vio-Blk-Blk-Brn
R7	100	Brn-Blk-Brn-Brn	Brn-Blk-Blk-Blk-Brn
R8,9	4.7M	1/4W 5% carbon:	Yel-Vio-Grn-Gld
R10	36k	Org-Blu-Org-Brn	Org-Blu-Blk-Red-Brn
R1	1.5k	Brn-Grn-Red-Brn	Brn-Grn-Blk-Brn-Brn
R12	1k	Brn-Blk-Red-Brn	Brn-Blk-Blk-Brn-Brn
R13,14	470k	Yel-Vio-Yel-Brn	Yel-Vio-Blk-Org-Brn

Capacitors
C1 3.3nF MKT (.0033, 3300)
C2 4.7uF 25VW RB electrolytic
C3 100uF 25VW RB electrolytic
C4,5,6 0.1uF ceramic (0.1, 104)
C7 47nF 630VW polyester (0.047uF, 473)
C8 2.2uF 400VW polyester

Semiconductors
IC1 uA78S40 switchmode power controller
Q1 MJE340 NPN transistor
Q2 SCR: C106D, TYN404, etc
D1 1N4148 small signal diode
D2 1N4936 1A 400V fast diode

Miscellaneous
VR1 200k 5mm vertical trimpot
VR2 10k 5mm vertical trimpot
L1,T1 trigger transformer
1 x 15cm length of spaghetti sleeving for flash tube wiring; 1 x 10cm length of 0.71mm tinned copper wire; 2 x PCB pins; PCB 39 x 81mm, coded ZA-1209.

but its frequency is determined by the external 3.3nF capacitor C1. The frequency is 13kHz and the pulses have an on time/off time ratio (duty cycle) which is internally set to 85%.

Although the flash tube is designed for a maximum flash rate of up to 100 per second, this circuit is designed to provide maximum flash rates of only about five per second.

One limiting factor is the temperature rise in L1, which will be excessive at higher flash rates when operating at the high end of the supply voltage range.

A second limiting factor, which is also related to the characteristics of L1, is the rate at which C8 is charged. With an 8V supply it takes about 500 milliseconds to charge to 290V and only 100 milliseconds at 15V; so with an 8V supply the full voltage and hence full brightness is only achieved at the minimum flash rate and it will decrease in brightness and eventually misfire at flash rates greater than about five per second.

Specifications

Dimensions (L x W x H)	81 x 39 x 28mm
Supply Voltage Range	8 to 15V
Supply Current	25 to 160mA (average)
Flash Rate	0.7 to 5 per second, variable

The 78S40 has an in-built current limit facility with current sensing via pin 14. If the voltage drop across R5 exceeds about 0.3V then the output pulse is cut off.

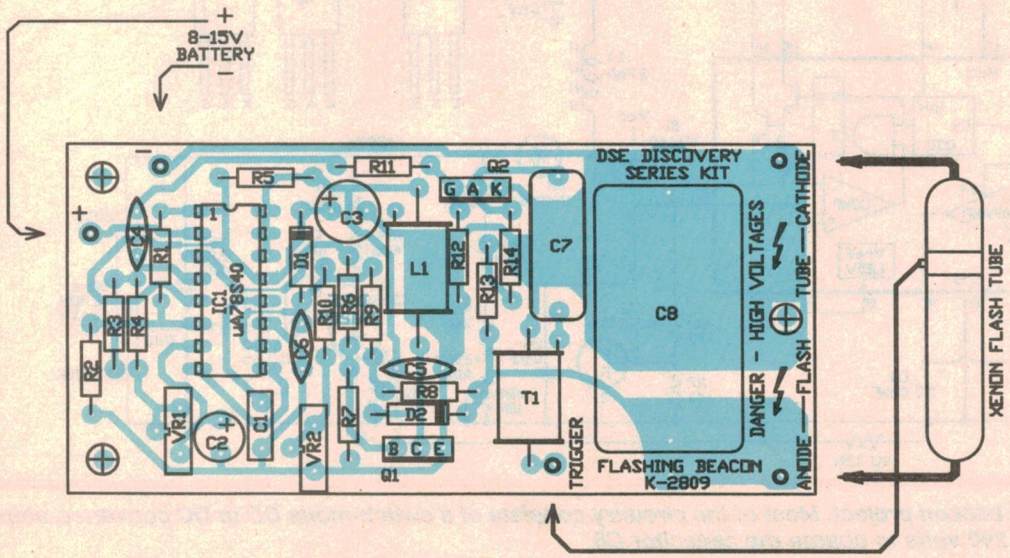
This offers protection mainly for Q1, under temporary fault conditions.

Construction

To mount the components on the PCB, start with the low profile components first and then work your way up to the larger components.

To place the components, refer to the overlay diagram which shows how the components actually appear on the PCB. Read the label of the component, e.g. C5, from the overlay and then look up the description next to that label in the parts list. For example, C5 is a ceramic type capacitor and has the value 0.1uF; it may be marked either 100n, 0.1 or 104.

Begin construction by installing the resistors R1 to R14. These resistors have their values marked on them as a colour code, which is given in the parts list.



This overlay diagram for the flashing beacon PCB shows where all of the components go — including the xenon tube itself. Note that inductor L1 is actually a trigger transformer and identical to T1.

The last band of the colour code gives the tolerance value and is the one that is farthest from the others. Resistors can be mounted in either direction, but it is good practice to mount them with their colour codes all in the same direction for ease of reading the values later.

Next install diodes D1 and D2. These must be connected with the banded end as shown on the overlay.

Next install IC1, ensuring that the end with the notch in it is at the same end as shown on the overlay.

Capacitors C2 and C3 are polarised types which have a positive (+) and a negative (-) lead. Usually the (-) lead is marked on the side of the case. The overlay shows where to position the (+) lead.

For transistor Q1 and SCR Q2, the metal face is shown on the overlay as a double line on one of the long edges.

Special care must be taken with the mounting of the flash tube because of the high voltages involved. The end of the tube closest to T1, and also the trigger wire, must be kept away from other conductors and should be insulated with the spaghetti sleeving provided.

Note that in the DSE kit for this project, the inductor supplied for L1 is actually another trigger transformer — identical to that used for T1. The primary wire is unused, being soldered to a pad on the PCB which 'goes nowhere'. When the assembly of the board is complete, carefully check all the soldering. Look especially for dry solder joints, and any solder bridges which may be shorting tracks together.

As mentioned earlier, the completed project should be encased in a plastic or earthed metal case with a clear or translucent sheet over the flash tube to prevent accidental contact with the high voltages.

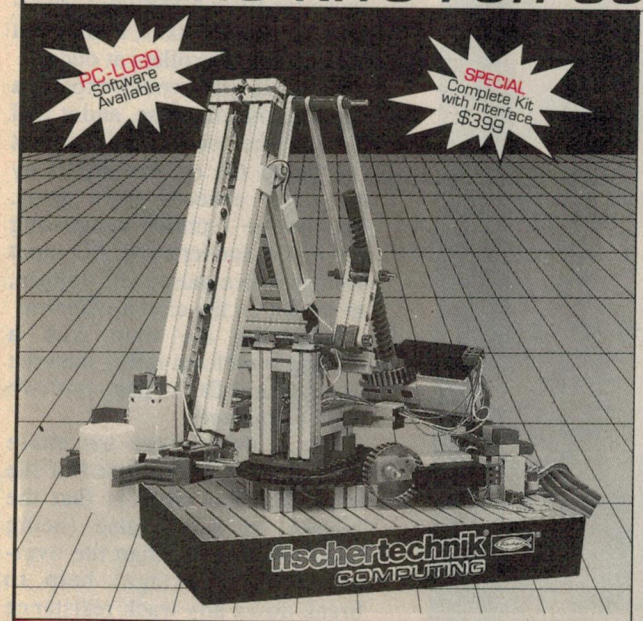
Adjusting the HV

Before connecting power to the kit, rotate the sliding contact on VR2 fully in the direction away from the edge of the board, for minimum voltage. Next, temporarily solder a wire strap across R12 (gate to cathode of Q2) to prevent the flash tube from being triggered. Now connect a DMM or other high-impedance voltmeter, set to a range greater than 400V, across the ends of the flash tube.

Connect the power supply and adjust VR2 until a reading of 290V is obtained. Disconnect the power supply and remove the strap from across R12. The flash rate can then be adjusted, keeping in mind that the greater the flash rate the greater the power consumption. ❖

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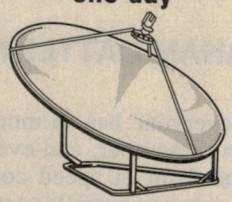
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Construction project:

MODEL TRAIN CONTROL WITH SIMULATED INERTIA

This simple, low-cost model train controller uses a very efficient phase control system to regulate the speed of your model train, giving better load-speed regulation. It also simulates inertia and momentum, making the train run much more realistically. Together with a couple of other features this makes the controller a worthwhile addition to almost any layout.

by GRAHAM CATTLEY

Almost everyone has an model train of one sort or another, and every train needs some form of speed controller. The average train controller consists of a multi-tapped secondary on a step-down power transformer. While crudely effective, these controllers have their drawbacks — trouble starting at low speeds being the most annoying.

Admit it, how many times have you turned the throttle up to high speed just to get the train moving, only to have it shoot off the rails, and put yet another hole in the scenery?

The reason that low speed starts are so difficult is that very low voltage is not enough to kick the motor into action, overcoming inertia and static friction. There's also the problem of electrical resistance between the track and wheels and/or collector brushes for the motor itself.

Another drawback of a simple controller is the lack of realism in starting and stopping. An average gauge model train stops in a few hundred milliseconds; this equates to a scale deceleration of about 4G!

This project addresses these problems, and as we kept the number of parts to a minimum, the design is very cheap and easy to build. One major cost saving is that you can use a small AC plug pack to power the train, instead of the large and expensive multi-tapped transformers usually associated with model trains.

The circuit

As mentioned earlier, this controller uses phase control to regulate the speed of the train, and as you might expect, the circuit is based around the silicon controlled rectifier (SCR) on the right of the circuit diagram.



To explain the operation of the circuit in detail, however, we'll start over on the left hand side with the power supply components F1, C4, L1 and D1 to D4. L1 and C4 prevent any high frequency voltage spikes generated by the controller from affecting other circuits that may be powered by the same transformer.

These spikes can be a bit of a problem, particularly if you are running more than one controller off the same supply, as the spikes from one unit can interfere with another's operation. The coil-capacitor filter effectively 'swallows up' these spikes, letting you run several controllers at once.

F1 is, as you would expect, a circuit protection fuse, and it will blow if the total circuit current (including the current drawn by the train) exceeds three amps. The bridge rectifier comprising D1 to D4 converts the AC input voltage into a pulsed DC voltage, as shown on the circuit diagram.

Supplying the train with a pulsing waveform rather than the usual steady DC voltage has two main advantages.

One is that we can use phase control to vary the speed of the train, and the other is that the 'peaks' of each pulse (being higher in voltage than the overall average voltage) help to break down any track resistance and give the train a more reliable starting characteristic. Anyway, back to the circuit.

When the 'GO' button (PB1) is pressed, capacitor C1 charges through D5, preset pot VR2 and the top half of Throttle pot VR1. When fully charged, C1 will have a voltage (more or less) equal to the voltage on the wiper of VR1, across it.

The time taken for C4 to charge to this voltage depends upon the setting of VR2, and can be varied over the range from zero to around three seconds. This slowly rising voltage corresponds directly to a slowly rising speed of the train, as we shall see a bit later on.

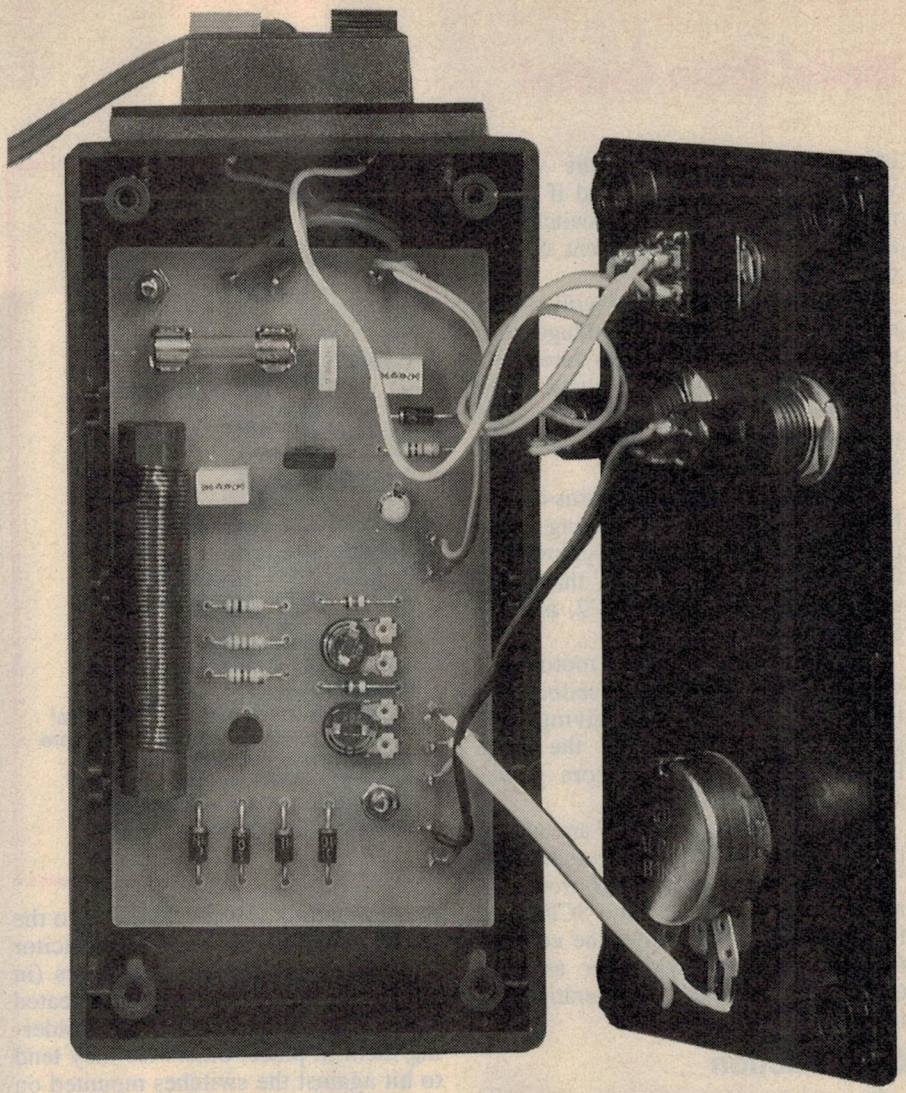
When PB1 is released, C4 slowly discharges through D6, VR3, and the bottom half of VR1. The voltage on the capacitor falls at a rate set mainly by VR3, bringing the train to a stop as the capacitor voltage reaches zero.

D5 and D6 ensure that the charge and discharge currents flow through their respective trimpots, giving complete control over acceleration and deceleration times.

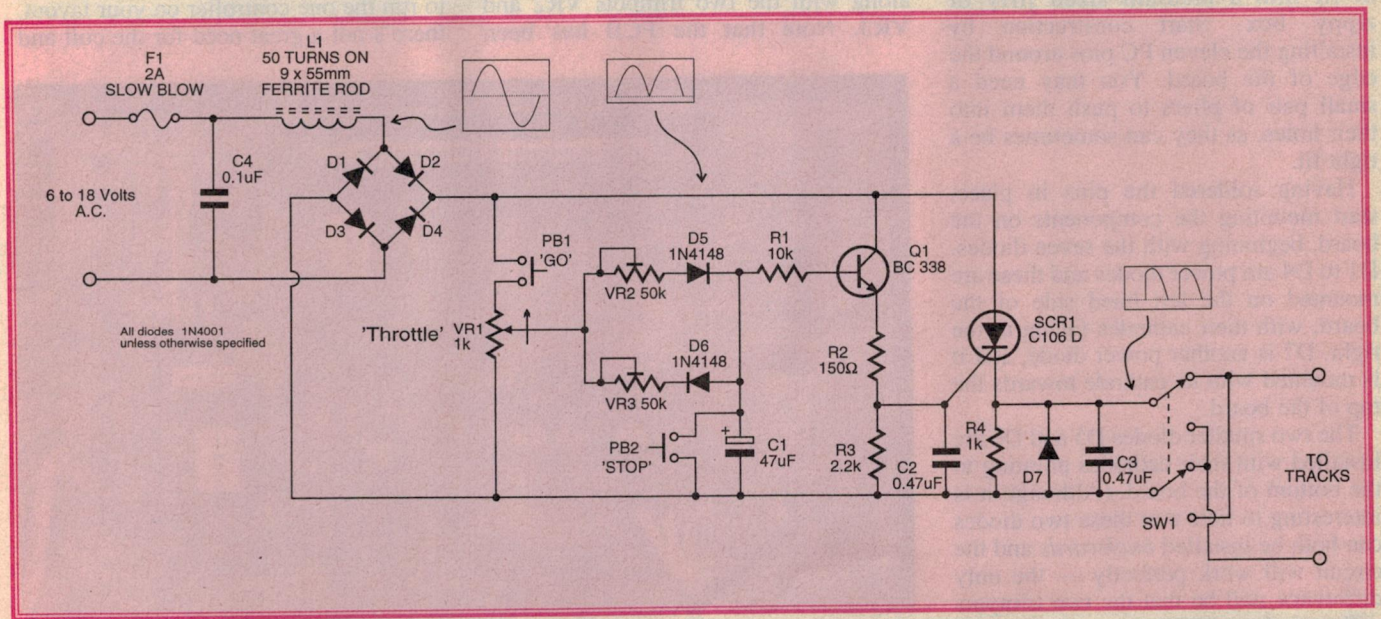
The 'Emergency Stop' button (PB2), when pressed, shorts out C4 and produces 0V on the base of Q1 regardless of the Throttle or 'Go' button positions, stopping the train instantly.

Q1 is configured as an emitter follower, giving a low impedance output into the gate of the SCR. This transistor acts as a buffer between the SCR and C1, preventing the SCR's gate current from discharging the capacitor.

The SCR and associated components (R3, R4 and C2) form the actual speed control circuitry; a voltage-to-train-speed converter, if you like. The SCR



An internal view of the controller, showing the internal wiring to the pot and switches. Note that we used a speaker connector for the track connection in the prototype.



The circuit diagram for the Train Controller is shown above, along with the waveforms you would expect to find at different parts of the circuit. The light bulb used for short circuit protection is not shown.

effectively compares its gate voltage with its cathode voltage, and if this is more than 0.6V, the SCR switches on and stays on until the current through the device falls to zero.

Because we are dealing with a fully rectified waveform, the voltage (and thus the current) will fall to zero every 10ms. As we raise the DC voltage on the base of Q1, its emitter follows it, and C2 thus takes less time to charge up to the SCR's trigger voltage.

This means that the SCR turns on earlier in the cycle, transferring more power to the loco. Conversely, lowering the control voltage means that more time is taken in charging C2, and the SCR turns on later.

The back EMF from the motor provides a large amount of feedback to the cathode of the SCR, giving very good speed regulation — the more load on the motor, the more power supplied by the SCR.

Capacitor C3 and diode D7 are used to prevent any spikes or commutator 'hash' from the loco's motor from disrupting the operation of the SCR. And finally switch SW1 allows the connections between the controller and the track to be swapped, for operating the train in either direction.

Construction

The train controller is constructed on a PCB measuring 55 x 100mm and coded 95tc10, and has been designed to fit into a medium sized jiffy or zippy box. Start construction by installing the eleven PC pins around the edge of the board. You may need a small pair of pliers to push them into their holes, as they can sometimes be a tight fit.

Having soldered the pins in place, start mounting the components on the board, beginning with the seven diodes. D1 to D4 are power diodes and these are mounted on the left hand side of the board, with their cathodes facing to the right. D7 is another power diode, and it is mounted with its cathode towards the top of the board.

The two smaller diodes D5 and D6 are installed with their cathodes pointing to the bottom of the board. (Although it is interesting to note that these two diodes can both be installed *backwards* and the circuit will work perfectly — the only difference will be that the two trimpots will swap functions!)

Next mount the four resistors and four capacitors, paying attention to the polarity of the electrolytic capacitor C1. Make sure that the capacitors (in fact *all* of the components) are seated firmly against the board before soldering them in place, otherwise they tend to hit against the switches mounted on the box lid.

Locate the two fuse clips in their respective holes, and solder them in along with the two trimpots VR2 and VR3. Note that the PCB has been designed to accommodate either the vertical or horizontal mount trimpots, but you'll find the horizontal style a lot easier to adjust once the PCB is mounted in the case.

Q1 and the SCR are next. These are soldered in as shown in the overlay diagram, although you may come across a couple of different case styles for the SCR — both styles fit in the same way round though, with the front of the device facing the fuse holder and the metal tab away from it.

As noted earlier, L1 is an RF choke used to prevent electrical noise generated by the controller from interfering with other circuits on the same power supply. As it is situated in the main power line, it will need to carry the full load current of the train, which can peak as high as 2A.

To this end, the coil needs to be wound with a fairly heavy gauge wire — something around 0.7 to 1mm.

If you don't happen to have a reel of the appropriate gauge wire handy, try using solid core hook-up wire from a length of four-core ('two pair') telephone style cable. You'll need around 1.5 metres of it, and a 50mm length of ferrite rod.

The rod's dimensions aren't at all critical, and almost any piece of rod (perhaps from an old transistor radio) will do. Wind on 50 or so turns, securing the ends with tape, and solder it to the board. (Note that if you are only going to run the one controller on your layout, there's not a great need for the coil and

PARTS LIST

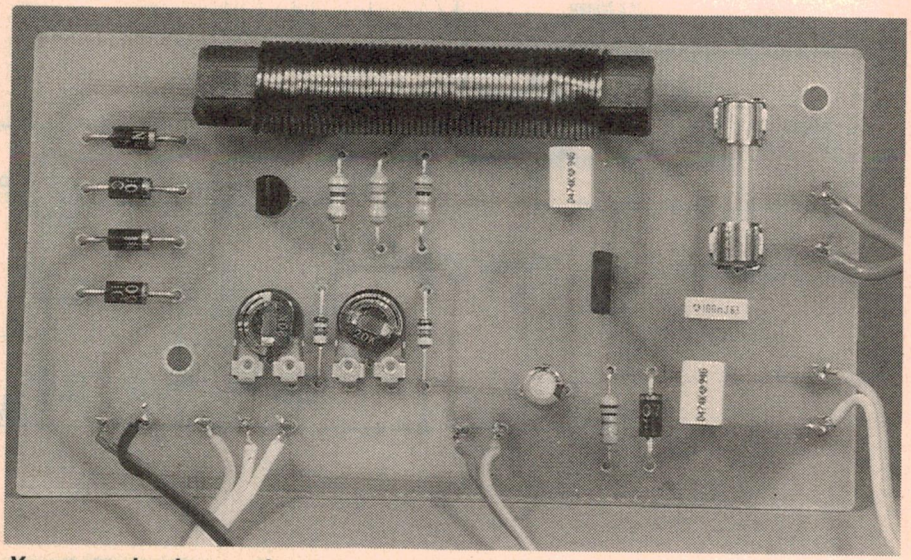
Resistors
(All 1/4W 5%):
R1 10k
R2 150 ohms
R3 2.2k
R4 1k

Capacitors
C1 47uF 25VW electrolytic (see text)
C2,C3 0.47uF MKT
C4 0.1uF MKT

Potentiometers
VR1 1k linear
VR2,VR3 50k horizontal trimpot

Semiconductors
D1-D4,D7 1N4001 power diode
D5,D6 1N4148 signal diode
Q1 BC338 NPN small signal transistor
SCR1 C106-D sensitive gate SCR

Miscellaneous
2A 3AG slow-blow fuse and PCB clips; 50 x 9mm ferrite rod; 160cm single core insulated wire (see text); 2 x push-on momentary SPST push-button; DPDT toggle switch; 20mm knob; Mounting hardware; hookup wire, solder, etc.



You can clearly see the two trimpots used for setting the acceleration and deceleration times in this photo, along with the RF choke L1.

it could be replaced with a wire link.)

Mark out and drill the box lid, using a copy of the front panel artwork as a guide, and also drill a couple of holes in one end of the box, one each for the lead to the transformer and one for that to the tracks.

We used a low cost speaker connector for the track connection, as this let us use the unit on a couple of different layouts without having to repeatedly resolder the leads in place. If you elect to do something similar, you will need to drill the required mounting holes in the box.

Mount the pot and three switches in the lid, and connect them to the main board with short lengths of hook-up wire as shown in the parts overlay diagram and photo.

Forward/Reverse switch SW1 is wired as shown in the diagram, with the diagonally opposite terminals joined together. Run a short length of wire from each middle terminal to the board, and leads from either pair of end contacts to the train tracks.

The only thing left to do as to install a 3A slow-blow fuse and screw on the lid. But before you do that, you will need to determine the maximum current drawn by your train. Using your trusty multimeter and some form of 12V power supply, measure this, and if it is under 1A, then no problems.

If, however, your train draws more than one amp, you will need to attach a small heatsink to the SCR. Also bear in mind that while the SCR has a peak current rating of 4A, its continuous forward current rating is only 2.5A; so don't attempt to control any of those 1:10 scale models of the XPT with it...

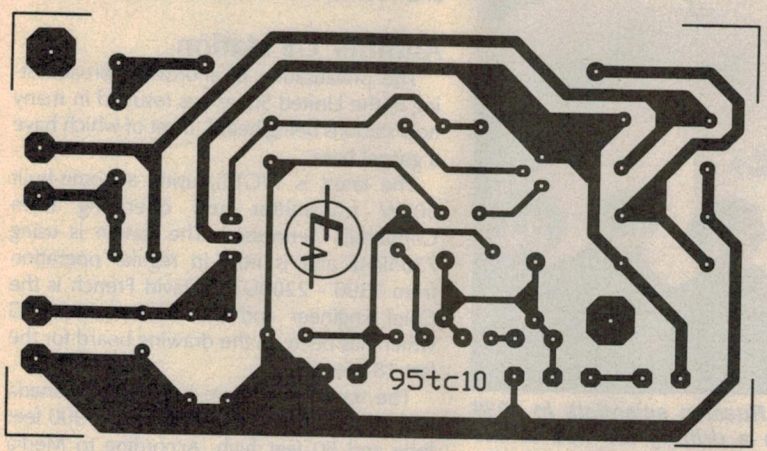
A bright idea

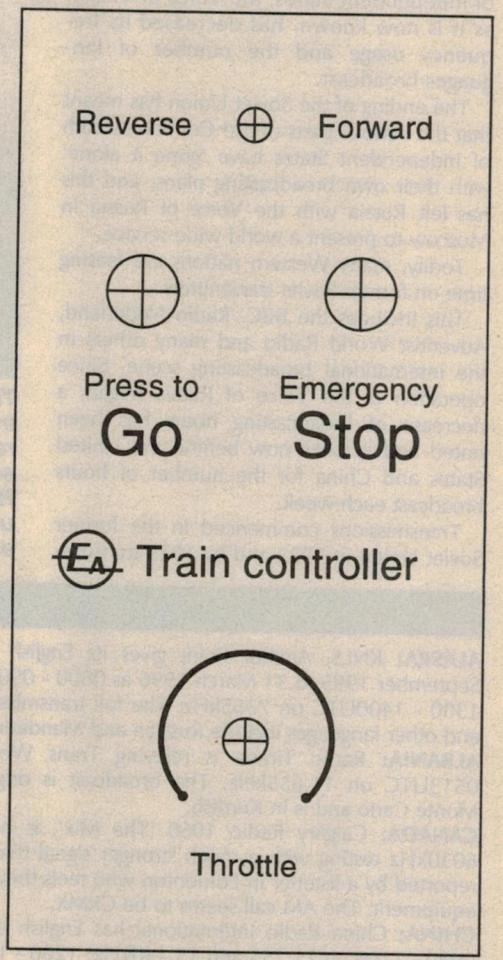
Now, have a rummage around in your junk box, and find a low wattage 12V light bulb — something around 10 - 15 watts should do. No, you aren't going to attach it to the engine so that you can 'keep on trainin' into the wee small hours. Just connect it in series with one side of the track connections. This will provide the very useful feature of short circuit protection.

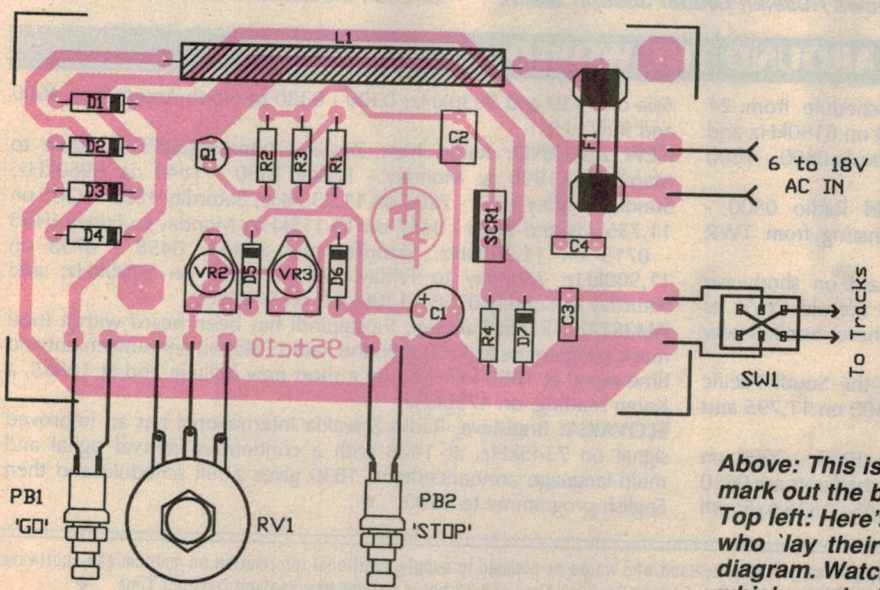
Why do you need short circuit protection when there is a perfectly good fuse inside the controller? Well, after you have replaced the fuse every time the train de-rails and shorts across the tracks, you'll soon see why...

As a side effect, the positive temperature coefficient of the bulb seems to smooth out any little bumps and jolts

Continued on page 114







Above: This is the front panel artwork. Use a copy of it to mark out the box lid before drilling.
Top left: Here's the actual full size PCB artwork, for those who `lay their own tracks'. And here's the PCB overlay diagram. Watch the orientation of the diodes, and the SCR which need a heatsink — see text.

SHORTWAVE LISTENING

with **Arthur Cushen, MBE**

Russian broadcasts decrease as Moscow has a new role

Most listeners will be aware that during the Cold War Radio Moscow operated on a tremendous number of frequencies, for world wide coverage. Transmitter power ranged from 50 - 2000kW and the transmitters were spread across Eastern Europe to the Far East and Siberia, as part of the mammoth Moscow service to meet a world wide audience and to challenge broadcasts from Western Europe.

But since the ending of the Soviet Union and the break up into the Commonwealth of Independent States, the Voice of Russia, as it is now known, has decreased its frequency usage and the number of languages broadcast.

The ending of the Soviet Union has meant that the various parts of the Commonwealth of Independent States have 'gone it alone' with their own broadcasting plans, and this has left Russia with the Voice of Russia in Moscow to present a world wide service.

Today, many Western nations are leasing time on former Soviet transmitters.

This includes the BBC, Radio Nederland, Adventist World Radio and many others in the international broadcasting scene. Since operation of the Voice of Russia began, a decrease of broadcasting hours has been noted and it ranks now behind the United States and China for the number of hours broadcast each week.

Transmissions commenced in the former Soviet Union in 1922 and by 1929 transmissions were on longwave, mediumwave and shortwave and in that year, the Foreign Service began with broadcasts in English, French and German. By the start of World War II Radio Moscow had stepped up its broadcasts in foreign languages to 21, and 10 years later this had increased to 88 languages and over 2000 hours of broadcasting each week.



These four Russian scientists in 1938 travelled on a drifting ice floe in the region of the North Pole. This was the subject of a verification from Moscow Radio for my reception on 12,000kHz using the call RNE. The card also shows Russian Leader Joseph Stalin.

The ending of the Cold War in 1991 found Radio Moscow without a cause, and various transmitters were in some of the new Independent States. This meant that Moscow had lost the use of many transmitters, though it still retained a sizeable number within the new Russia Republic.

The Voice of Russia is still a major voice on shortwave, though the number of frequencies in use have gradually declined as well as the number of languages broadcast. No doubt the staff of 1500 employees are pondering the future of what the role of the Voice of Russia will be in the years to come.

The Voice of Russia has broadcasts to Australia from 0600 - 1100UTC in hourly blocks and some of the frequencies used throughout are 17,590kHz and 17,870kHz. News is featured on the hour every hour. Moscow Mailbag is a question and answer programme with Joe Adamov, heard Sunday and Tuesday after the news at 0600UTC.

Another US station

The privatisation of shortwave broadcasting in the United States has resulted in many new stations being heard, most of which have a gospel base.

The latest is WGTG, using a home-built 50kW transmitter and operating from Copperhill, Tennessee. The station is using 7355kHz and is now in regular operation from 1300 - 2200UTC. David French is the Chief Engineer and the owner of WGTG which has been on the drawing board for the last 18 months.

The transmissions are beamed to Canada and Mexico, using a Rhombic aerial 900 feet long and 90 feet high. According to Media Network, the address of the station is WGTG, PO Box 1131, Copperhill, Tenn. 37517, USA. The call WGTG stands for 'With Glory to God'; the station is undenominational. ❖

AROUND THE WORLD

ALASKA: KNLS, Anchor Point gives its English schedule from 24 September 1995 to 31 March 1996 as 0800 - 0900 on 6150kHz and 1300 - 1400UTC on 7365kHz. The full transmission is 0800 - 1800 and other languages include Russian and Mandarin.

ALBANIA: Radio Tirana is relaying Trans World Radio 0500 - 0513UTC on 11,635kHz. The broadcast is originating from TWR Monte Carlo and is in Kurdish.

CANADA: Calgary Radio 1060 'The Mix', is heard on shortwave 6030kHz testing with a much stronger signal than the old CFVP, as reported by a listener in Edmonton who feels they have installed new equipment. The AM call seems to be CKMX.

CHINA: China Radio International has English to the South Pacific 0900 - 1100 on 11,755 and 15,440kHz; 1200 - 1300 on 11,795 and 15,440kHz; and 1300 -1400UTC on 15,440kHz.

MONGOLIA: Ulaanbaatar has English to Europe 1930 - 2000 on 7530kHz and is also announcing 4080kHz. Other broadcasts are 0910 - 0940 to Australia on 9960kHz and 12,000kHz; 1445 - 1515 to South Asia on 7530 and 9930kHz; 0300 - 0330 to North America on 4000 and 9960kHz.

NEW ZEALAND: Radio New Zealand International's schedule to March 16, 1996 is: Monday - Friday 1650 - 1849 on 5960kHz; Sunday - Friday 1850 - 2205 on 11,735kHz; Saturday 1855 - 2205 on 11,735kHz and 2006 - 0457 on 15,115kHz; Monday to Friday 0458 - 0715 on 11,900kHz; Saturday and Sunday 0458 - 0758 on 11,900kHz; Monday to Friday 0716 - 1206 on 9700kHz; and Saturday to Sunday 0758 - 1206UTC on 9700kHz.

PAKISTAN: Radio Pakistan, Rawalpindi has been heard with a local music programme at 1750 then the Radio Pakistan announcement and time signal at 1800 followed by a short new bulletin and at 18055, a Koran reading, on 4790kHz.

SLOVAKIA: Bratislava, Radio Slovakia International has an improved signal on 7345kHz, at 1828 with a continuous interval signal and multi-language announcement. 1830 gives a full schedule and then English programme to 1900. ❖

This item was contributed by Arthur Cushen, 212 Earn Street, Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 11 hours behind Australian Eastern Daylight Time and 13 hours behind New Zealand Daylight Time. ❖

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EA OCT'95

LED BATTERY VOLTAGE INDICATOR

Here's a flexible circuit that can be used in just about any piece of battery operated equipment, to combine the functions of a power-on LED and battery voltage indicator. Measuring only 25mm square, the circuit can be easily mounted in the smallest of spaces, to give you warning of impending battery failure.

EA ***SEPT'95***



K10690 **$9.95**

PC- DRIVEN ELECTROCARDIOGRAM

This simple project will let you take your own electrocardiograph, and display it on a PC. With the software supplied, you can read, display, save to disk and print the electrical waveform generated by your own heart (or anyone else's). Powered by a 9V battery and electrically isolated from the computer, the PC-ECG is a safe, low cost way to monitor the electrical activity of the heart



EA ***JULY '95*** K10680 **$29.95**

A PHOTOGRAPHIC TIMER FOR DARKROOMS

If you are looking for an accurate way to control film developing times, then take a look at this Photographic Timer. It will switch on mains-powered fluorescent ultraviolet tubes or incandescent lamps rated at up to 1200W for a preset time ranging from 1 - 450 seconds.

Silicon Chip April '95



K10665 **$64.95**

A FAST CHARGER FOR NICAD BATTERIES NEW

K10700 **$118.95**

NO PICTURE AVAILABLE AT TIME OF PUBLICATION

This nicad charger lets you fast charge nicad battery packs from a 12V car battery. It can charge packs of 5 to 10 cells at once and automatically reverts to trickle mode at the end of the charging cycle. **SC *OCT '95***

IMPROVED FLEXITIMER MK2

This simple but extremely flexible circuit can be used for just about any semi-fixed timing applications, with its ability to select timing periods from seconds to days. It has four separate outputs, two independant and programmable timing "events", can be sychronised awith the 50Hz mains or driven by an internal RC clock, and can be powered from either an AC or DC source.

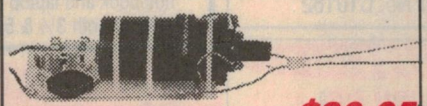


K10685 **$22.95**

EA ***AUG'95***

JACOB'S LADDER DISPLAY NEW

Ever since scientific showmen like Tesla and Edison were able to generate really high voltages, the Jacob's Ladder display has been creating awe amongst laymen. **SC SEPT'95**



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LOW COST TRANSISTER & MOSFET TESTER NEW

This handy tester is designed to plug into a digital multimeter to provide accurate measurement of transistor beta, to values up to 50,000 or more. You can use it to test small signal, power & Darlingtons transistors &, as a bonus, it will check Mosfets.

SC ***May '95***



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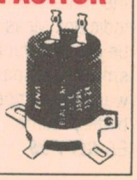


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- Perfect travel companion for notebook and laptop users.
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2500µ 63V RG CAPACITOR
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Holds 10 disks.
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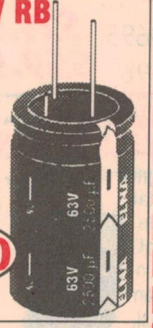


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SPEAKER TYPE:
- Full range 2 x 2- 1/4"
- Impedance: 4 - 8 ohms
- Frequency response: 100 -12,000Hz
- Dimensions: 76W x 110H x 46D mm

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SINGLE END CAPACITOR RB
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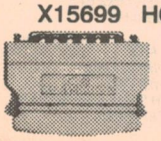


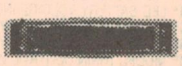
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X15699
HONDA 50M Terminator (Active)

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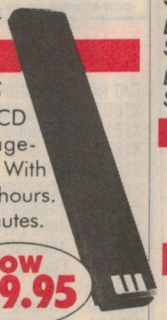


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M212- Extra high capacity NiCD battery (B/DG/SG/LG). Voltage- 7.2. Capacity is 1,500 mAh. With estimated standby time of 26 hours. Estimated talk time of 120 minutes.



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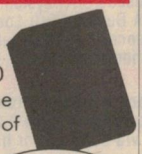


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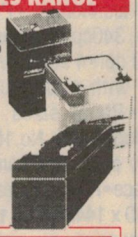
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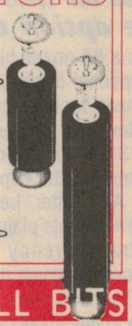
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DB9 metalized backshell, with short thumb screws for DB9 connectors



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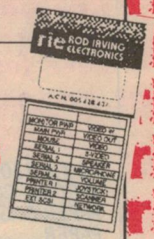
DB25 metalized backshell, with short thumb screws for DB25 connectors



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COMPUTER PORT LABELS STICK ON

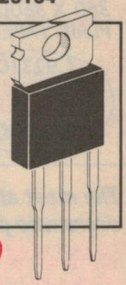


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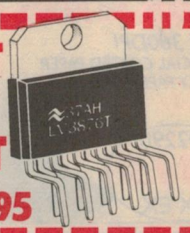
Z10101 1-9 $1.50 10+ $1.25

BUZ11 F1 INSULATED TAB POWER MOSFET



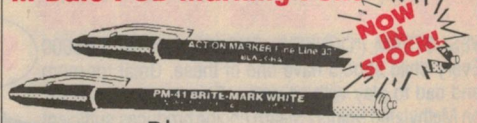
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A mid-range inkjet printer, the Stylus Color II is designed for those who need fast, high quality colour output. Excellent value for money!

EPSON STYLUS COLOUR II



720 X 720DPI SPECIAL COATED PAPER & GLOSSY PAPER.

360 X 360DPI ON PLAIN PAPER.

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C92310 **$656** TAX EX.

This is a 64-nozzles (black), 3 x 20 nozzles (Magenta, Cyan, Yellow), colour inkjet printer • Multi-layer Actuator print head technology • Print speed: 400cps/LQ 20 cpi • Maximum resolution: 720 x 720 dpi • 4 scalable fonts • 5 bitmap LQ fonts • Friction feed with paper feeder • EPSON ESC/P2. IBM X24/X24E • Paper sizes: A4, Letter, B5, Legal, Statement, Executive, Envelopes (DL No.10) Index card (A6) • Accepts plain, special coated or glossy paper, and transparency film • Centronic® type 8-bit parallel interface/Macintosh® serial interface • Exclusive black & colour ink cartridge • 433W x 248D x 198H mm. **12 MONTHS WARRANTY**

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The most affordable colour in the Stylus Family. This well featured inkjet is designed for users who print mainly in monochrome, but also have occasions when they need colour.

EPSON STYLUS COLOUR IIs



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360 X 360DPI ON PLAIN PAPER.

$659 TAX INC.

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This is a 64-nozzle colour/black inkjet printer. It uses a black or colour ink cartridge • Multi-layer Actuator print head technology • Print speed: 250 cps/LQ 20 cpi in black, 340cps in colour mode • Maximum resolution: 720 x 360 dpi • 4 scalable fonts • 3 bitmap LQ fonts • Friction feed with paper feeder • Up to 100 sheets at 64 gsm • Paper sizes: A4, Letter, Legal, Statement, Envelopes (DL No.10) • Accepts plain, special coated or glossy paper, and transparency film • Bi-directional parallel interface • Pack includes black & colour ink cartridges • 397W x 206D x 144H mm. **12 MONTHS WARRANTY**

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This entry level inkjet model is designed for those users who want a low cost monochrome printer with the option to upgrade to colour.

EPSON STYLUS 820



720 X 360DPI SPECIAL COATED PAPER &GLOSSY PAPER

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C92290 **$419** TAX EX.

This is a 64-nozzle black inkjet printer (colour capable with optional colour upgrade kit) • Multi-layer Actuator print head technology • Print speed: 250 cps/LQ 20 cpi • Maximum resolution: 720 x 360 dpi • 4 scalable fonts • 3 bitmap LQ fonts • EPSON ESC/P2 • Friction feed with paper feeder • Up to 100 sheets at 64 gsm • Paper sizes: A4, Letter, Legal, Statement, Envelopes (DL No.10) • Accepts plain, special coated or glossy paper, and transparency film • Bi-directional parallel interface • Exclusive ink cartridge • Dimensions: 397W x 206D x 144H mm. **12 MONTHS WARRANTY**

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Upgrade printhead and colour cartridge to make this printer become a Stylus Colour IIs!
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Pentium™ 60	$1695	**$1995**
Pentium™ 75	$1979	**$2249**
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DX2-80	$1969	**$2219**
DX4-100	$1939	**$2239**
Pentium™ 60	$1999	**$2279**
Pentium™ 75	$2399	**$2699**
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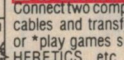
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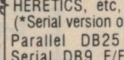


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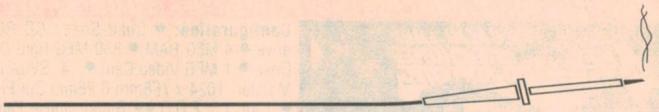
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Experimenting with Electronics

by DARREN YATES, B. Sc.



Operational amplifiers unplugged

This month, we take our first look at operational amplifiers or 'op-amps'. Many circuits once performed only by using a significant number of transistors can now be easily and cheaply built using these now commonplace components.

Before we jump into op-amps, the last Experimenting with Electronics won't be the last instalment of transistor circuits. I've only just scratched the surface, I admit, so we'll be looking at more transistor-only circuits down the track. But this month seemed to be a good time to branch out into the new area.

When the first op-amps appeared in the late 1960s, they were quite delicate devices. Easy to blow up and break, you had to handle them with kid gloves. They were pretty expensive to boot. These days, op-amps are commonplace and quite cheap as well — which also means that there are thousands of circuits using these devices floating around in books, magazines and texts.

Most early op-amp circuits were designed for two power supplies — a negative and positive side with a common ground. Now while this is OK if you have a dual power supply, it can be a little nasty if you only have a single rail supply or wish to run the circuit off batteries.

Since then, most circuits have been readily adapted to work off a single supply. But there are some that still require a second supply in order to perform their desired function.

What are they?

So what are op-amps? Well, if you're interested in the minute theory, there is a very good *Electronics Australia* publication that was produced some years back called *Op-Amps Explained*. This is a good read if you're interested in going into them that deeply, but for the sake of those who are just interested in building the circuits, we'll keep the explanations brief.

To put it simply, op-amps are *amplification building blocks*, chock-full of gain at frequencies from DC to upwards of 1MHz. You can apply varying amounts of both positive and negative feedback to obtain different effects. They can perform basic and more complicated mathematical functions. They can also perform basic comparisons between two voltages, and a host of other functions.

These characteristics make the op-amp incredibly versatile — in some ways, just as versatile as transistors. The benefit of these components is that while they do integrate a large number of transistors inside, they are now such a fundamental building block, and can quite easily fill a theory book on their own.

Right. That's enough waffle — now let's look at some circuits.

In the beginning...

These first circuits may be incredibly boring to most, but in the scheme of things, they provide us with a good foundation to build on. If you haven't seen an op-amp circuit before, then this is the best place to start.

Our first circuit, in Fig.1, is a non-inverting amplifier with a gain of 11. Op-amps have the ability to amplify DC voltages, which means that if we connected a voltage of 0.5V to the input, the output would be close to 5.5V. This is highly important to remember because it can easily be forgotten and cause all sorts of problems when you just want to amplify AC signals.

Looking at the circuit, the 'closed-loop' or final gain is set by the ratio of the feedback resistors R1 and R2,

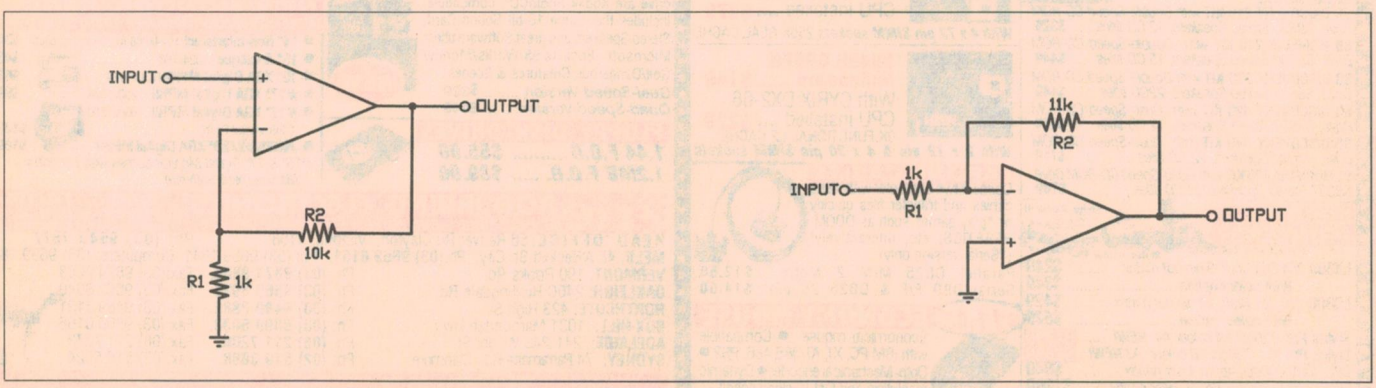


Fig.1 (left): A non-inverting DC amplifier. Fig.2 (right): An inverting DC amplifier.

according to the equation:

gain A = 1 + (R2/R1)

so with our 10kΩ and 1kΩ resistors we get A = 1+(10/1) = 11.

The term 'closed-loop' is used here to identify to external component feedback loop which sets the gain of the op-amp. Op-amps also have what is called their 'open loop' gain. This is the maximum gain the op-amp has — it's not always useable, but important to know.

The LM358 dual op-amp IC has an open-loop gain of around 20,000, which is more than most circuits need. But we'll come across quite a few cases where other factors require more than one op-amp to be used to amplify a signal.

The term 'non-inverting' means that the output signal is in the same phase as the input signal — i.e., it's not inverted. Op-amps have the ability to amplify either in or out of phase, simply depending upon which input you use. As you can see, this circuit feeds input signal to the non-inverting input (designated by the '+' symbol) to obtain this result.

Fig.2 is a slightly different circuit. It amplifies the signal by the same amount, but the output is out of phase with the input — hence we call it an *inverting* amplifier. Amplifying DC signals using a single supply rail is tricky at the best of times, so these first few circuits require both a positive and negative rail.

The main difference between Fig.2 and Fig.1 is that here the input signal is coupled to the inverting input via one of the feedback resistors. Note that the feedback resistors are still connected between the output and the inverting input. The non-inverting input in this case is connected to ground.

The gain in this case is calculated by a slightly simpler equation:

gain A = R2/R1

It's simply the ratio of the two feedback resistors. Note that the output feedback resistor in this circuit is 11kΩ and not 10kΩ as in the previous one.

Again, since this is a DC amplifier, if we feed in a +0.5V input signal, the output will be 5.5V *below* the supply rail (whereas with the non-inverting amplifier it would be 5.5V *above* ground.) This is because of the inversion, which makes it look like it's working 'upside down'.

Now while these two circuits are not terribly practical, they allow us to see how the basics of an op-amp work. op-amps have many little tricks and traps, and it will be much easier to explain them along the way rather than getting stuck into masses of theory now.

Simple audio amp

Fig.3 is a circuit that has been around for yonks, but is one of the easiest circuits to get going. Using the very common LM741 op-amp IC, this circuit requires only one supply rail. The reason for this that the biasing for the op-amp's input is achieved using two resistors, which biases the input at half the supply rail.

This circuit will amplify audio frequencies with a gain of 48 and can be used to boost the level of a dynamic microphone. The input signal is AC-coupled to the non-inverting input, which is set to 6V via the two 100kΩ bias resistors. The feedback resistors here are 47kΩ between the output and inverting input and 1kΩ to a 10uF isolating capacitor to ground.

The capacitor here ensures there is an AC signal path to ground, without any DC flow. This keeps the output (with no input signal) stable at 6V. When the input signal is applied, the output signal will move about this 6V mark.

If you quickly look back at the equation for the non-inverting amplifier, you'll see that the circuit has a gain of 1 for DC signals.

The 1kΩ resistor and 10uF capacitor together act as a high-pass filter, which causes the lower frequencies to become more and more attenuated or reduced. Frequencies below 16Hz are progressively reduced, while frequencies above this are allowed to pass through, basically unaffected.

For those who want a little more information, this point is called the '3dB' frequency and can be easily worked out by the following equation:

$F_{3dB} = 1/(2 \times \pi \times R \times C)$

where $\pi = 3.1415927$, R is the resistor value in ohms and C is the capacitor value in farads.

Tone control stage

A further extension along this line is the commonly found 'feedback tone control' stage shown in Fig.4. Most audio amplifier projects and many commercially built amplifiers use a circuit very similar to this.

This circuit provides around 20dB of both bass and treble boost and cut

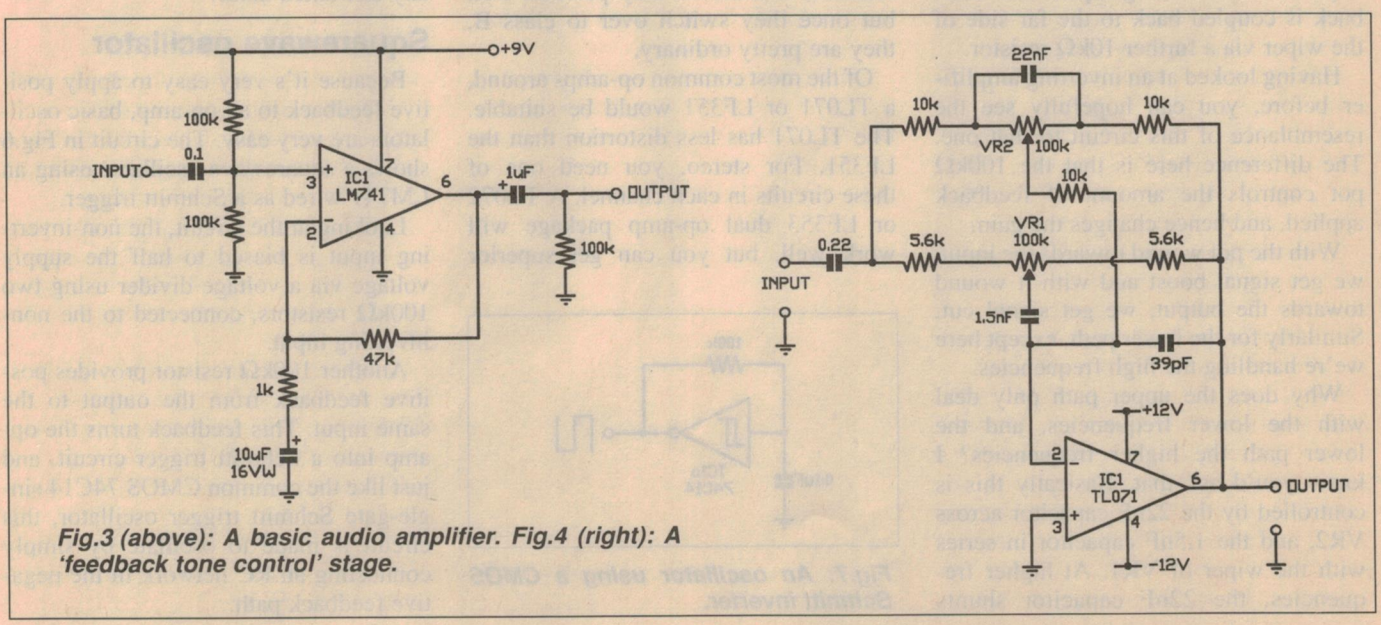


Fig.3 (above): A basic audio amplifier. Fig.4 (right): A 'feedback tone control' stage.

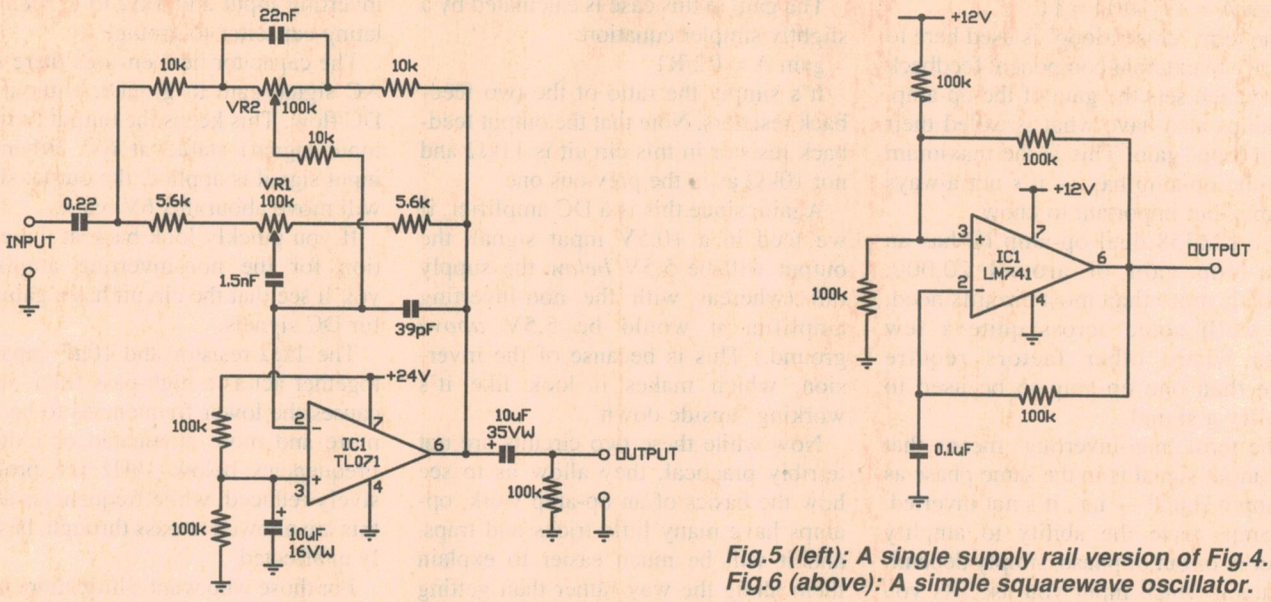


Fig.5 (left): A single supply rail version of Fig.4.
Fig.6 (above): A simple squarewave oscillator.

and is suitable for just about any audio purpose. The circuit makes use of the op-amp's ability to easily accept negative feedback. You can see this by the connection of the output back to the input circuitry.

Looking at the circuit, the input signal is divided down two paths. The top path handles the lower frequencies — i.e., those below 1kHz — and the lower path those above 1kHz.

If we look at the top path for a moment, you can see that the input signal passes through the 10kΩ resistor, 100kΩ pot and a 10kΩ resistor via the wiper to the inverting input. The feedback is coupled back to the far side of the wiper via a further 10kΩ resistor.

Having looked at an inverting amplifier before, you can hopefully see the resemblance of this circuit to that one. The difference here is that the 100kΩ pot controls the amount of feedback applied, and hence changes the gain.

With the pot wound towards the input, we get signal boost and with it wound towards the output, we get signal cut. Similarly for the lower path, except here we're handling the high frequencies.

Why does the upper path only deal with the lower frequencies, and the lower path the higher frequencies? I knew you'd ask that. Basically this is controlled by the 22nF capacitor across VR2, and the 1.5nF capacitor in series with the wiper of VR1. At higher frequencies, the 22nF capacitor shunts VR2 with such a low capacitive reactance that it's 'shorted out', and loses any control. Conversely at lower frequencies, the 1.5nF capacitor in series with VR1's wiper becomes such a high capacitive reactance that the wiper is 'disconnected'.

The op-amp used in this circuit should not be based on an LM324 or LM358 package. These op-amps have quite high crossover distortion and don't perform well under normal audio conditions. The basic reason is that they switch between class A and B operation once a certain current flow has been reached. In class A, they perform well but once they switch over to class B, they are pretty ordinary.

Of the most common op-amps around, a TL071 or LF351 would be suitable. The TL071 has less distortion than the LF351. For stereo, you need one of these circuits in each channel. A TL072 or LF353 dual op-amp package will work well, but you can get superior channel separation by using single op-amp packages.

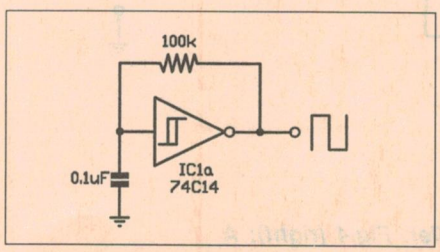


Fig.7: An oscillator using a CMOS Schmitt inverter.

Power for this circuit can come from either single or dual rail supplies, with the overall voltage being around 24V (+/-12V for dual supplies).

If you want to run the circuit with a single 24V supply, you need to add two 100kΩ biasing resistors as shown in Fig.5. This lifts the DC bias level to half the supply voltage and ensures the maximum possible output level without clipping. The 10uF capacitor ensures that the non-inverting input, which is now a reference point is 'clean' and free from any unwanted noise.

Squarewave oscillator

Because it's very easy to apply positive feedback to an op-amp, basic oscillators are very easy. The circuit in Fig.6 shows a squarewave oscillator using an LM741 wired as a Schmitt trigger.

Looking at the circuit, the non-inverting input is biased to half the supply voltage via a voltage divider using two 100kΩ resistors, connected to the non-inverting input.

Another 100kΩ resistor provides positive feedback from the output to the same input. This feedback turns the op-amp into a Schmitt trigger circuit, and just like the common CMOS 74C14 single-gate Schmitt trigger oscillator, this circuit is made to oscillate by simply connecting an RC network in the negative feedback path.

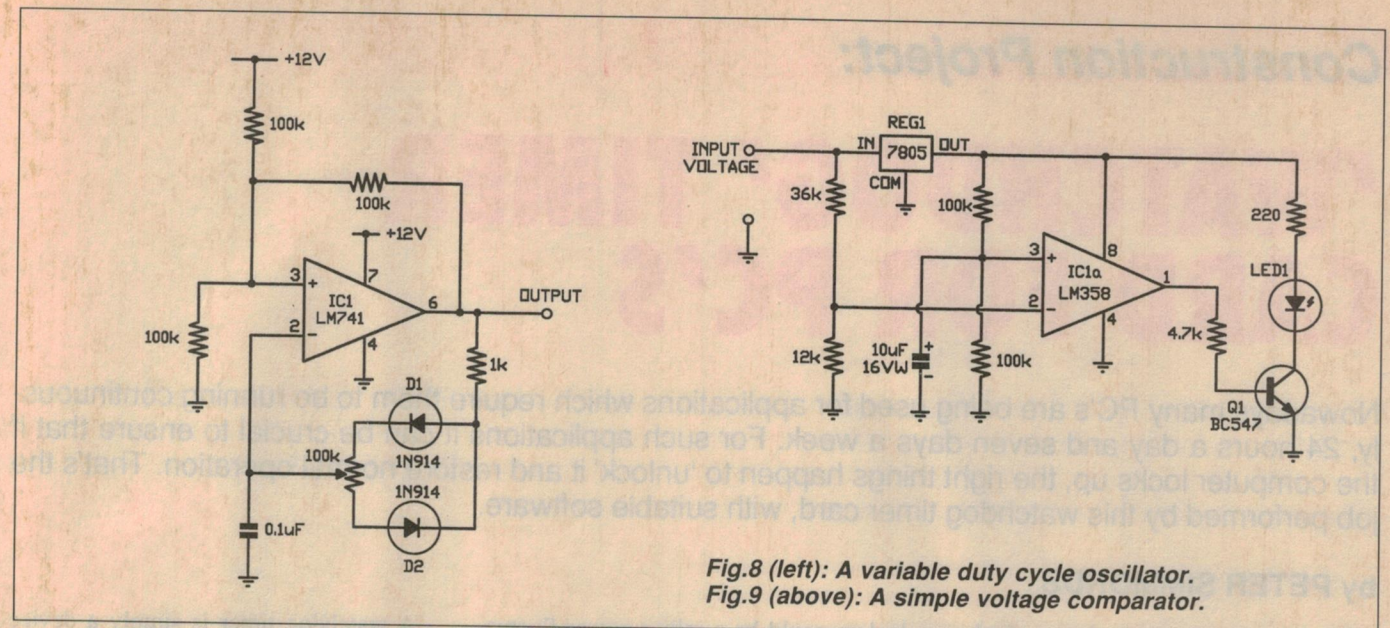


Fig.8 (left): A variable duty cycle oscillator.
Fig.9 (above): A simple voltage comparator.

The frequency of oscillation is directly set by the negative feedback resistor and the timing capacitor. It's also a function of the hysteresis level set by the 100kΩ positive feedback resistor. It's worth experimenting with and seeing which different values of components can give you a set frequency.

The CMOS circuit shown in Fig.7 works in the same way, but suffers from the problem that the internal trigger threshold voltages are never constant between different ICs — whereas the thresholds for the op-amp circuit in Fig.6 are set by the three resistors in the positive feedback network. The CMOS circuit could easily vary in frequency by a range of 4:1, depending upon the CMOS package you get — even though you're using the same external components.

As a simple rule, the smaller the positive feedback resistor is in value, the wider the threshold range will be and vice-versa. This is a circuit crying out for experimentation. Replacing the negative feedback resistor with a 100kΩ pot and a 4.7kΩ series resistor will turn the circuit into a variable squarewave oscillator.

Varying the duty cycle

Another variation possible with this circuit is to move the variable frequency pot, add two diodes and turn the circuit into a fixed frequency variable-duty cycle oscillator. The circuit for this is shown in Fig.8.

As you can see, the wiper of the 100kΩ pot is now connected to the inverting input of the op-amp, with both sides of the pot now connected to the output via oppositely connected diodes. These diodes allow us to control the charge and discharge characteristics of the feedback timing capacitor. The wiper of the pot allows us to control how fast the capacitor charges and discharges, and this directly relates to the duty cycle or 'high-low ratio' of the waveform. Also, as the total resistance of the pot doesn't change (it's always 100kΩ), the frequency remains constant.

This circuit, or the basis of it anyway, is often used in controlling motors such as drills and model railway locos. Next month, we'll turn this circuit into both a model railway controller and a hobbyist drill speed controller.

Voltage comparator

So far, we've looked at the op-amp's ability to work as both an amplifier and a Schmitt trigger. One of its other recognised roles is as a *comparator*. As its name suggests, a comparator compares two voltages and can tell us which voltage is higher or lower depending upon the voltage state you need.

I remember when I first came across the concept of a comparator, it was very helpful for me to think of it like an 'IF...THEN' statement from a BASIC computer program.

The circuit in Fig.9 is a simple circuit which indicates when the input voltage falls below 10V. It's ideal to use as a simple warning for your car battery.

Again, looking at the circuit, a 7805 regulator supplies a clean supply as well as a reference voltage of 5V. (Note: 7805 regulators have a basic accuracy of 5V +/-0.25V.

For more precise circuits, there are voltage references which are far more accurate than this.) Using a voltage divider of two 100kΩ resistors, the non-inverting input becomes our reference point of 2.5V.

Another voltage divider drops the voltage straight from the battery down so that when the battery voltage drops to 10V, the inverting input falls below 2.5V. With the non-inverting input now higher than the inverting input, the output of the comparator changes its state from low to high, and transistor Q1 is turned on to light up the red LED.

From this, the direct voltage divider has to have a ratio of 4:1. Making the ground resistor 12kΩ and the 'hot' resistor 36kΩ gives us the exact ratio we need. The circuit uses the LM358 dual op-amp IC because it can work from a supply voltage of as little as 3V and is designed for single supply rails.

There are many other important issues to consider when designing op-amp circuits, and we'll continue our look at them individually next month with some more circuits. ❖

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Construction Project:

'WATCHDOG' TIMER CARD FOR PC'S

Nowadays many PC's are being used for applications which require them to be running continuously, 24 hours a day and seven days a week. For such applications it can be crucial to ensure that if the computer locks up, the right things happen to 'unlock' it and restore normal operation. That's the job performed by this watchdog timer card, with suitable software.

by PETER SIMMONDS

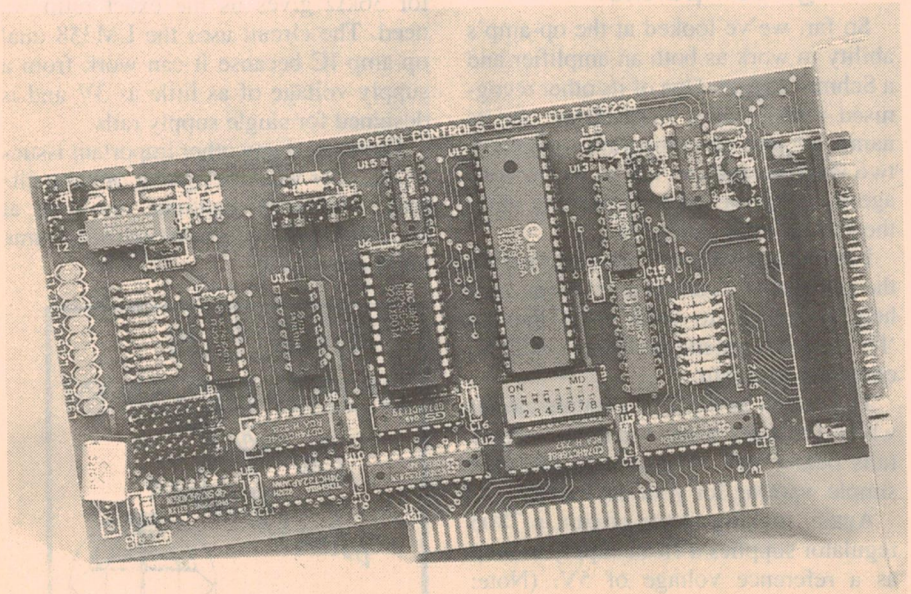
The PC industry's growth over the last decade has been phenomenal, from the perspective of both hardware and software. Because of the power of both, more and more different applications are now being run on PCs. Applications that once could be found only on mainframes, minicomputers and workstations are now being switched to run on PCs.

Many of these programs such as word processing, spreadsheets etc., are only run for a few hours at a time, while others operate 24 hours a day every day of the week and are the only program running on the PC. Members of this latter group include applications such as servers, bulletin boards, process control monitoring etc., and they have to be very reliable with a minimum of downtime.

There are times though, when a computer could lock up. The reason for this lockup could be a minor power fluctuations, a bug in the software, an operator's incorrect response, etc. Because of the critical nature of these 24 hour a day applications, the downtime period has to be minimised as much as possible and operators alerted to the fact of the malfunction.

As an example of software bugs causing lockups, I was developing a piece of software for a client but it would inexplicably crash every one or two days. In order to give myself some breathing space to solve the problem, and do the other half-dozen things I had to do — and more importantly keep the client happy — I installed a 'watchdog timer' to make sure the system kept operating until I found the cause of the problem.

It was in fact with this kind of application in mind that I decided to develop the PC watchdog timer described here.



A watchdog timer is simply a device that the PC has to continually pulse. If the period between two pulses exceeds the timeout period of the timer, or the pulses cease to occur, then the timer will assume the PC has lost control and it will reset the PC to restore normal operation.

Now how does the PC generate these pulses? If you are writing custom software to run on the PC, this is very easy to achieve. You insert instructions in your software to periodically write to a particular I/O address.

The problem arises for those people who are using software from a third-party software house and cannot change the code to produce a pulse for the WDT. Hence I decided to allow the WDT to be pulsed by an external pulse.

How can this be of use, you ask? Well, if you running a bulletin board or a process control package, the software will probably be generating signals from the serial or parallel ports. These signals can be used as the pulses for the watchdog timer card.

After further thought I came up with a list of additional requirements:

a) The timeout period had to be adjustable from a fraction of a second to many minutes, and be done through software.

b) There had to be a signal from the watchdog timer board that could be easily connected to the outside world to activate a light or siren, to alert the operater that a computer lockup had occurred.

c) The board should be configured so that either the operator could initiate the reset, or the WDT would automatically do this.

d) There should be a count of the number of resets that the watchdog timer

'Watchdog' Timer Card for PC's

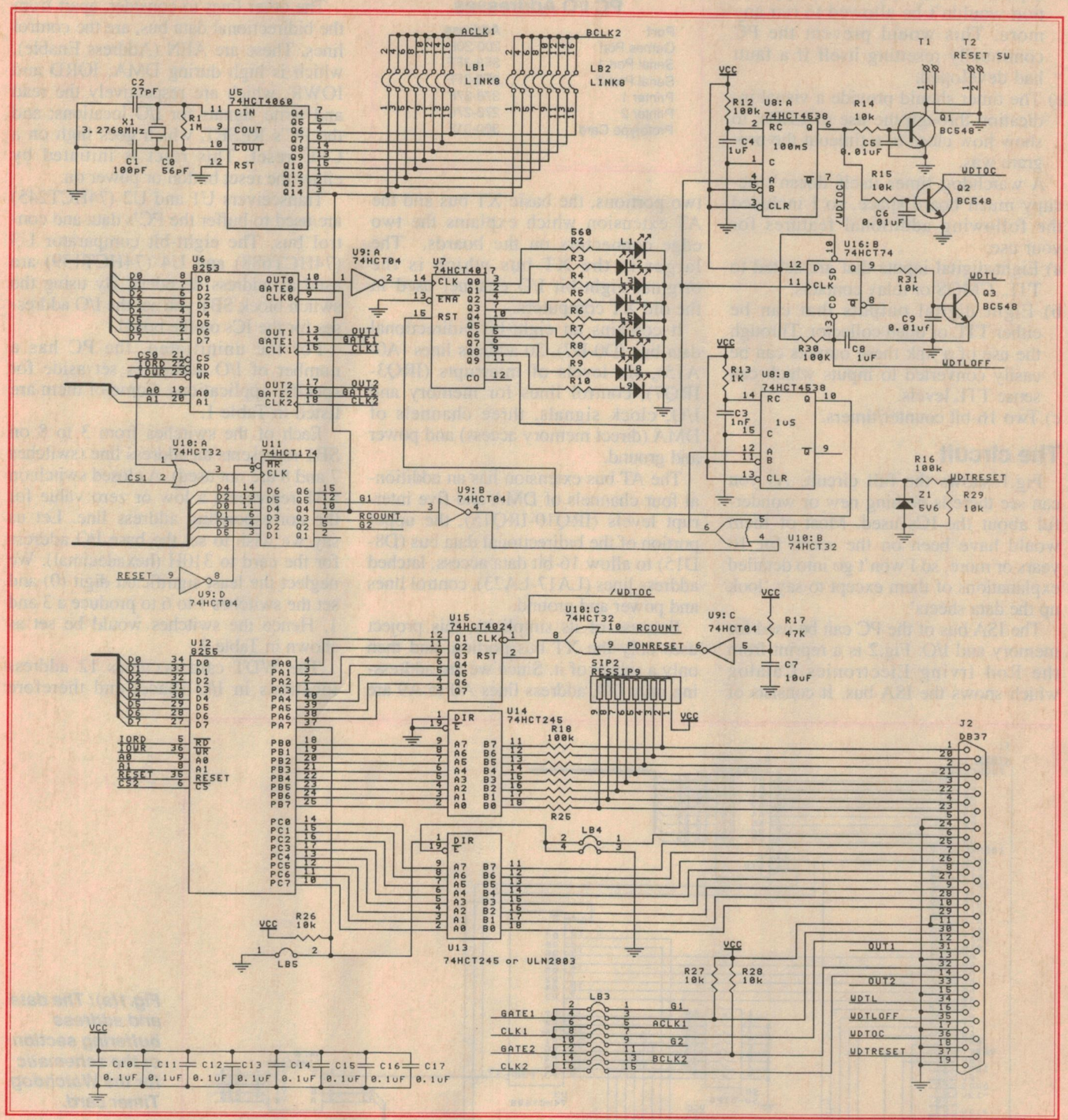


Fig.1(b) : The remainder of the Watchdog Timer card schematic, showing the timer circuitry itself at the top and the 'bonus' digital I/O circuitry at the bottom.

would occupy the address block 310H to 31BH. Hence the full address map for the card would be as shown in Table 3.

In order to use the card in your PC make sure the address you choose doesn't conflict with the addresses used by any other cards in your PC. The documentation that came with the PC cards should tell you the addresses they use.

The biggest problem associated with designing the WDT for a PC is the long boot-up times a PC can have. From the time of the reset to the actual application program running could be as long as a minute or more. During this time you want the watchdog timer disabled, because if it was allowed to reset you would never get your application running.

Another fly in the ointment, so to speak, is the user must have control over the timeout period through the use of software. Hence this ruled out the use of

had initiated. If the count exceeded a preset number, then the application wouldn't be allowed to run any more. This would prevent the PC continually resetting itself if a fault had developed.

e) The timer should provide a visual indication through the use of LEDs, to show how close to a timeout the program was.

A watchdog timer itself doesn't occupy much board space, so I included the following additional features for your use:

a) Eight digital inputs that are suited to TTL, CMOS or relay contacts.

b) Eight digital outputs that can be either TTL or open collector. Through the use of a link these outputs can be easily converted to inputs which can sense TTL levels.

c) Two 16-bit counter/timers.

The circuit

Fig.1 shows the full circuit. As you can see there is nothing new or wonderful about the ICs used. Most of them would have been on the scene for 10 years or more, so I won't go into detailed explanations of them except to say 'look up the data sheets'.

The ISA bus of the PC can be used for memory and I/O. Fig.2 is a reprint from the Rod Irving Electronics Catalog which shows the ISA bus. It consists of two portions, the basic XT bus and the AT extension which explains the two edge connectors on the boards. The larger is the XT bus which is the original eight-bit I/O channel used in the old XT computers.

It contains an eight-bit bidirectional data bus (D0-D7), 20 address lines (A0-A15), six levels of interrupts (IRQ3-IRQ7), control lines for memory and I/O, clock signals, three channels of DMA (direct memory access) and power and ground.

The AT bus extension has an additional four channels of DMA and five interrupt levels (IRQ10-IRQ15), the upper portion of the bidirectional data bus (D8-D15) to allow 16-bit data access, latched address lines (LA17-LA23), control lines and power and ground.

Because of its simplicity, this project uses only the XT bus portion, and then only a subset of it. Since we are addressing only I/O, address lines A0 to A9 are used, hence there are only 1024 address locations for I/O.

TABLE 1

PC I/O Addresses

Port	Address
Games Port	200-20F
Serial Port 1	3F8-3FF
Serial Port 2	2F8-2FF
Printer 1	378-37F
Printer 2	278-27F
Prototype Card	300-31F

The other lines to consider, apart from the bidirectional data bus, are the control lines. These are AEN (Address Enable), which is high during DMA; IORD and IOWR, which are respectively the read and write signals for I/O locations; and the PC's RESET, which goes high on a CPU reset. This reset is initiated by either the reset button or power on.

Transceivers U1 and U2 (74HCT245) are used to buffer the PC's data and control bus. The eight-bit comparator U3 (74HCT688) and U4 (74HCT139) are used as address decoders. By using the switch block SB1 you set the I/O addresses for the ICs on the board.

For the uninitiated, the PC has a number of I/O addresses set aside for specific applications. Some of them are listed in Table 1.

Each of the switches from 3 to 8 on SB1 represents an address line (switches 7 and 8 are not used). A closed switch on SB1 represents a low or zero value for the corresponding address line. Let us say we wish to set the base I/O address for the card to 310H (hexadecimal). We neglect the least significant digit (0) and set the switches 1 to 6 to produce a 3 and 1. Hence the switches would be set as shown in Table 2.

The WDT card occupies 12 address locations in I/O space, and therefore

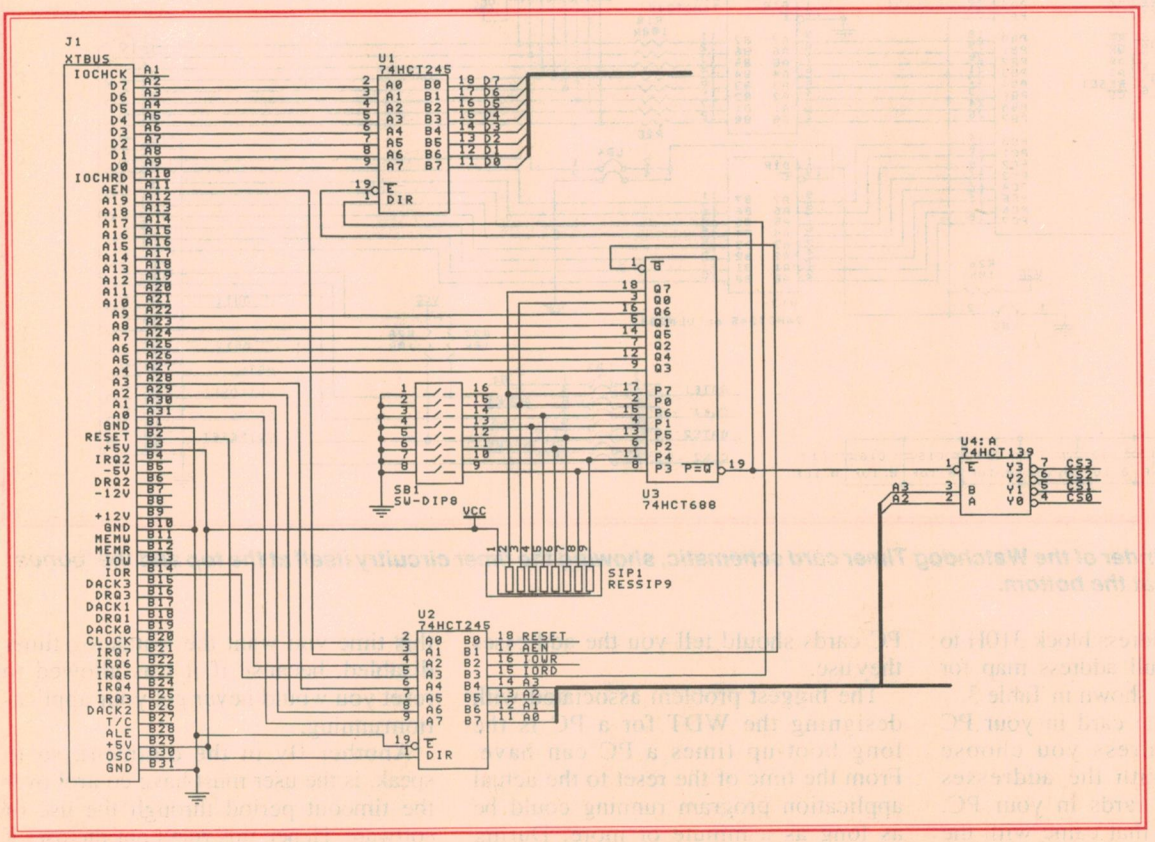


Fig.1(a): The data and address buffering section of the schematic for the Watchdog Timer card.

the microprocessor supervisory ICs such as the MAX690, and so I opted to use the 'old faithful' of timer/counters — the 8253. The 8253 contains three independent 16-bit counter/timers, each of which can be programmed in six different modes.

These modes are:

0. Interrupt on terminal count
1. Programmable one-shot
2. Rate generator
3. Square wave rate generator
4. Software triggered strobe
5. Hardware triggered strobe

The first IC to consider in the WDT circuit is U5 (74HCT4060), which is a 14-stage binary counter. The 3.2768MHz crystal X1 together with the resistor R1 and capacitors C0, C1 and C2 serves as the clock source for the IC.

This clock is then divided down by 16384 to produce a frequency of 200Hz at the Q14 output. The outputs Q6 to Q14 are also brought out, to two sets of links LB1 and LB2. These allow you to select a frequency ranging from 25.6kHz to 200Hz for lines ACLK1 and BCLK2 (See Table 4). These lines can be used as clock sources for counters 1 and 2 on the 8253.

The 200Hz signal from Q14 is directly connected to CLK0 of U6 (8253), which is the clock input for the 16-bit counter 0. In order for the WDT to operate, counter 0 is programmed to operate in mode 2 — i.e., as a rate generator. What this means is that when the counter is loaded with the value N, it will act as a divide by N counter. The counter's output will be high for the initial N-1 periods and low for the Nth period of the input clock.

Signal Name	I/O Pin		I/O Pin	Signal Name
GND	B 1		A 1	-I/O CH CK
RESET DRV	B 2		A 2	SD7
+5Vdc	B 3		A 3	SD6
IRQ9	B 4		A 4	SD5
-5 Vdc	B 5		A 5	SD4
DRQ2	B 6		A 6	SD3
-12 Vdc	B 7		A 7	SD2
OWS	B 8		A 8	SD1
+12 Vdc	B 9		A 9	SD0
GND	B 10		A 10	-I/O CH RDY
-SMEMW	B 11		A 11	AEN
-SMEMR	B 12		A 12	SA19
-IOW	B 13		A 13	SA18
-IOR	B 14		A 14	SA17
-DACK3	B 15		A 15	SA16
-DRQ3	B 16		A 16	SA15
-DACK 1	B 17		A 17	SA14
DRQ1	B 18		A 18	SA13
-Refresh	B 19		A 19	SA12
CLK	B 20		A 20	SA11
IRQ7	B 21		A 21	SA10
IRQ6	B 22		A 22	SA9
IRQ5	B 23		A 23	SA8
IRQ4	B 24		A 24	SA7
IRQ3	B 25		A 25	SA6
-DACK2	B 26		A 26	SA5
T/C	B 27		A 27	SA4
BALE	B 28		A 28	SA3
+Vdc	B 29		A 29	SA2
OSC	B 30		A 30	SA1

Signal Name	I/O Pin		I/O Pin	Signal Name
-MEM CS16	D 1		C 1	SBHE
-I/O CS16	D 2		C 2	LA23
IRQ10	D 3		C 3	LA22
IRQ11	D 4		C 4	LA21
IRQ12	D 5		C 5	LA20
IRQ15	D 6		C 6	LA19
IRQ14	D 7		C 7	LA18
-DACK0	D 8		C 8	LA17
DRQ0	D 9		C 9	-MEMR
-DACK5	D 10		C 10	-MEMW
DRQ5	D 11		C 11	SD08
-DACK6	D 12		C 12	SD09
DRQ6	D 13		C 13	SD10
-DACK7	D 14		C 14	SD11
DRQ7	D 15		C 15	SD12
+5Vdc	D 16		C 16	SD13
-MASTER	D 17		C 17	SD14
GND	D 18		C 18	SD15

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Fig.2: The pin connections for the IBM AT or 'ISA' bus, reproduced with permission from the RIE catalog.

The gate input is used to control the operation of the counter. When the gate is low, the output is forced high and counting is disabled.

On the gate going high, the counter will restart from the initial count N. 'Ahah!' I hear you say — if we pulse the gate periodically, then we prevent the WDT from timing out. That is true, but I've added a few more bells and whistles...

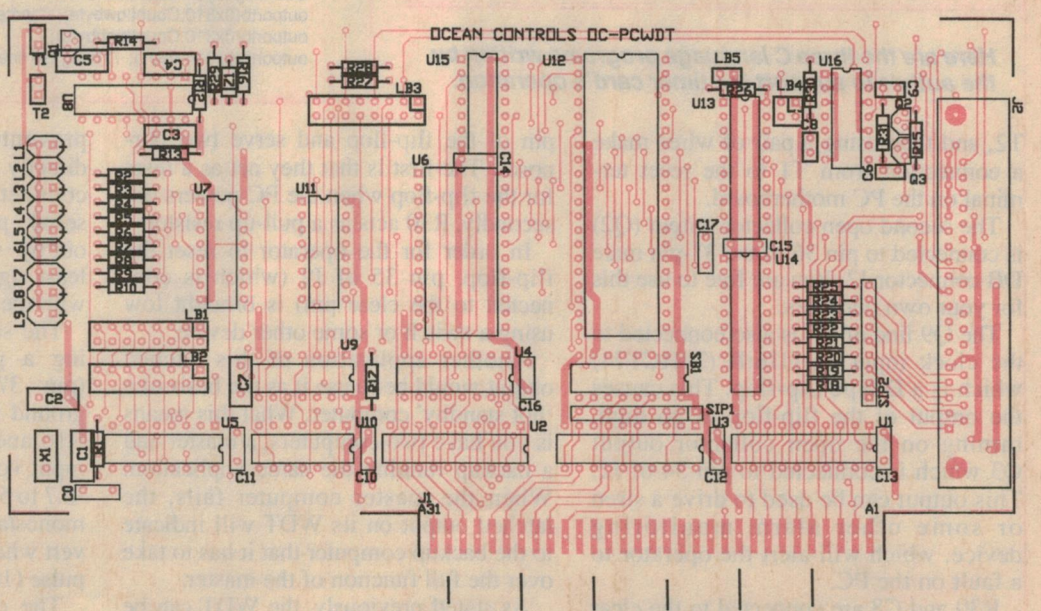
If you look at the gate input GATE0, you will see it is connected to the output Q0 of the hex D-type latch U11 (74HCT174). This latch has its reset input (MR) tied to the PC's reset line.

When the PC is reset, all of the outputs of the latch are low. Hence all three gates on the 8253 are low, and the counters are disabled — which means the WDT will be disabled during the boot-up of the PC. To activate the WDT, counter0 must first be loaded with the value N and then a byte written to U11, which brings the pin GATE0 high.

The output of counter 0 is connected to U7 (74HCT4017), which is a decade counter with 10 decoded outputs. Each of these outputs have a high intensity LED attached, which allows the user to observe to what extent the timeout period of the WDT is being approached. During the timeout period you will see the LEDs (L1 - L9) sequentially light up.

Output Q9 of U7 is connected to a monostable U8:A (74HCT4538). If the WDT times out, Q9 goes high which then triggers the monostable to produce a 100ms pulse. This pulse is tied to two transistors (Q1 and Q2), which act as open collectors. The collector of transistor Q1 is connected to terminals T1 and T2 and produces the reset pulse for the PC.

Unfortunately there is no CPU reset line on the ISA bus, so we have to be a little devious. If you look inside your PC you will probably find a connection from the front panel reset switch of the PC to the reset terminal on the motherboard. To gain access to the reset line, you simply connect the reset switch line to



If you build the Watchdog Timer card up from a kit, use this overlay diagram as a guide when fitting all of the components. Although the author is retaining commercial copyright to the PCB patterns and software, private individuals can obtain copies for their own use via our reader information service or by downloading from our computer BBS.

'Watchdog' Timer Card for PC's

LISTING 1
TESTWDT.C

```
#define ESC 0x1b
main()
{
int key,state;
int count,countlowbyte,counthighbyte,NoResets;
int Interval=20; /* timeout interval for WDT is 20 secs */
  clrscr();
  outportb(0x31b,0x92); /* set up the 8255's ports */
  state=0;
  outportb(0x313,0x34); /* set up the 8253's ports */
  count=Interval*200;  /* total pulses for timeout period */
  count=count/10; /* divide it by 10 due to 4017 */
  counthighbyte=count/0x100;
  countlowbyte=count%0x100;
  outportb(0x310,countlowbyte); /* write to the 8253 at 310H */
  outportb(0x310,counthighbyte);
  outportb(0x314,0x01);  /* bring G0 line high to start WDT */
printf("Press Esc to Exit, any other key to reset WDT\n");
  for(;;) {
       if((bioskey(1))) {
          key=bioskey(0);
          key=key%0x100;
          if(key==ESC) {
               outportb(0x314,0x00); /* disable the WDT */
               exit(0);
               }
          else {
               outportb(0x314,0x00);
               outportb(0x314,0x01);
               NoResets=inportb(0x318) & 0x7f; /* zero MSbit */
               printf("No of Resets is %d  ",NoResets);
               }
  printf("Press Esc to Exit any other key to reset wdt\n");
               }
          }
}
```

LISTING 3
WDTEND.C

```
main()
{
outportb(0x314,0x0);  /* bring the G0 line low */
}
```

Here are the three C language programs written by the author to support the timer card's operation.

LISTING 2
WDTBOOT.C

```
#include "stdlib.h"

main(int argc, char *argv[])
{
int ResetCount,PortStatus,MaxResets,Selection;
int Count,Countlowbyte,Counthighbyte;
    /* first check the number of parameters */
    if(argc) {
        printf("\n Invalid No. of parameters for Watchdog Timer");
        exit(0);
        }
    /* work out the Count for Counter0 */
    ResetCount=inportb(0x318); /* read the 8255 */
    PortStatus=ResetCount&0x80;
    if(PortStatus==0) {
        /* 8255 ports A,B,C are input,input,input respectively */
        outportb(0x31b,0x9b);
        }
    else {
        /* 8255 ports A,B,C are input,input,output respectively */
        outportb(0x31b,0x92);
        }
    ResetCount=ResetCount & 0x7f;
    printf("No of watchdog timer resets=%d\n",ResetCount);
    Count=atoi(argv[1]);
    MaxResets=atoi(argv[2]);
    if(MaxResets0) {
        if(ResetCountMaxResets) {
         printf("WARNING No of resets exceeds limit set of %d\n",MaxResets);
         printf("Press any Key to continue\n");
         /* something to catch your attention */
         while(!bioskey(1)) {
           sound(1000); delay(1000); sound(500); delay(1000);
           }
         bioskey(0);
         nosound();
        printf("\nSelect Alternative 1 or 2\n");
        printf("------------------------------------------------\n");
        printf("  1. Reset Counter and activate the WDT\n");
        printf("  2. Reset Counter but do not activate the WDT\n");
        printf("Selection - ");
        scanf("%d",&Selection);
        outportb(0x314,0x02); /* reset counter, bring RCOUNT high and low */
        outportb(0x314,0x00);
        if(Selection==2) exit(0);
        }
    }
    outportb(0x313,0x34);  /* set the mode of the Counter */
    Count=Count*200;  /* total number of pulses for timeout period */
    Count=Count/10;
    Countlowbyte=Count%0x100;
    Counthighbyte=Count/0x100;
    outportb(0x310,Countlowbyte); /* write to 8253 at address 0x310 */
    outportb(0x310,Counthighbyte);
    outportb(0x314,0x01);  /* bring G0 line high to start WDT */
}
```

T2, and then using a pair of wires make a connection from T1 to the reset terminal on the PC motherboard.

The second open collector output (Q2) is connected to pin 36 of the 37-pin male DB connector J2. You are free to use this for your own purposes.

The Q9 line of U7 is also connected to the clock input on U16:B (74HCT74) which is a D type flip-flop. This causes the output of the flip-flop to go high, turning on the open collector output Q3 which is connected to pin 34 of J2. This output can be used to drive a siren or some other alarm monitoring device, which will alert the operator to a fault on the PC.

R30 and C8 are connected to the clear pin of the flip-flop and serve two purposes. The first is that they act as a reset for the flip-flop when the PC powers on; secondly, R30 acts as a pull-up resistor.

In order for the operator to reset the flip-flop, pin 35 of J2 (which is connected to the clear pin) is brought low using a switch or some other device.

Another application of this latched output would be to use it as the basis of a 'hot standby' computer. What this means is you have two computers, a master and a backup running the same application. When the master computer fails, the latched output on its WDT will indicate to the backup computer that it has to take over the full function of the master.

As stated previously, the WDT can be prevented from timing out by either directly addressing an I/O location or by connecting an external signal from a serial port etc. The first is carried out by writing to U11, first with the least significant bit cleared and then with the bit set.

The second alternative is by connecting a pulse to the WDTRESET pin (pin 37) of J2. R29 is used to ground the line if it is not being used. R16 and Z1 are used to ensure that the input voltages are kept within the range -0.7 to 5.6V. The input then proceeds to a monostable U8:B, which is used to convert what may be slow level changes to a pulse (1us).

The other major IC used is a 8255,

TABLE 2
Switch settings for SB1

Switch	8	7	6	5	4	3	2	1
Address	-	-	A9	A8	A7	A6	A5	A4
Open/Closed			O	O	C	C	C	O
Address			1	1	0	0	0	1
			=3					=1

which is used to control the digital I/O on the board. The 8255 has three eight-bit ports A, B and C, which can independently configured as inputs or outputs. The configuration is achieved by writing a byte to the control byte.

In this circuit Port A operates as an input and it monitors the WDT reset counter U15 (74HCT4024). This counter counts the number of pulses that the WDT has generated in its operation. The counter is reset in two ways. The first is a power-on reset circuit consisting of R17, C7 and the gate U9:C. The second method of reset occurs by bringing the RCOUNT line on U11 (74HCT174) high. This is done by writing a byte to U11, first with bit 1 high and then with it low.

Port B can only be used as an input. Connected to this port B is U14 (74HCT245). Although I could have directly connected the pins of J2, I wanted to provide some robustness against high voltages and also be able to sense TTL, CMOS and relay contact levels. Each of the inputs has a 100k series resistor, to limit current input, and a 10k pullup resistor.

Unfortunately the 8255 is only suited to TTL levels and if you have a series resistor greater than 1 - 2kΩ, the input will not work correctly. So I placed buffer U14 (74HCT245) between portB and the 100k resistors.

Port C can have a 74HCT245 connected to it or a ULN2803. If you are using a 74HCT245 then the port can be used as an eight-bit input or output. Adjustments must be made to the control word and links LK4 and LK5 according to Table 5.

The ULN2803 provides eight Darlington transistor drivers and is much more suitable for operating heavier current loads than the 74HCT245. The ULN2803, which is an 18-pin device must be inserted into the socket with pin 1 of the ULN2803 occupying pin 2 of the socket (i.e., the ULN2803 occupies pins 2 to 10 and 11 to 19 of the socket).

Construction

Construction of the timer is fairly straightforward. You can use sockets for all the ICs if you wish, but I believe with a little care in regard to electrostatic discharge you really only need to provide sockets for the two larger IC's U12 (8255) and U6 (8253).

Mount all of the passive components first, followed by the LEDs, diodes and transistors — making sure their orientation is correct before soldering. Solder in the D37 connector and the links, followed by the IC's, again checking that their orientation is correct.

Now you will have to set the links and switch blocks on the card. Firstly set the address of the card by adjusting the switch block SB1 according to Table 2.

The second links to look at are LK1 and LK2. If you are going to use the clock sources ACLK1 and BCLK2 for counter/timer 1 and or 2, then place a link in the relevant position on LK1 and or LK2 according to Table 6.

Link3 determines what signals are going to be used for the clock and gate sources for counter/timers 1 and 2. You can control the gates by an external source via pins 30 and 32 J2 or via software control. Note there are pull-up resistors R27 and R28 on the external gate sources to allow open collectors or relays to operate the gates.

Links 4 and 5 have been previously discussed, and should be in their correct positions.

With the power off to your computer, insert the completed card into any of the ISA slots. If you are going to use the reset feature of the WDT, then look for the two wire cable which connects your front panel reset switch to the motherboard. When you have found it, determine which pin on the reset terminal is common.

This can be done by using a digital voltmeter. With one probe on a known common (pin 2 on T2) measure the voltage on each of the reset pins on the motherboard. One will measure +5V, the other (which is the common) will be 0V.

Disconnect the front panel reset button lead from the reset terminal on the motherboard and connect it to terminal T2 on the card. With another two-wire cable, make a connection betweenT1 and the reset connector on the motherboard — noting that the commons on T1 and the reset terminal are joined together.

If you find it is too difficult to disconnect either end of the reset switch cable, then you can always be a bit ruthless and cut it. You then solder the new two wire cable to the two halves of the old reset cable, noting that the common of the new cable is connected to the common of the old reset cable.

When you are satisfied that you have done everything correctly, turn the power on to your computer and it should boot up normally.

TABLE 3
Card I/O addresses (based at 310H)

U6 8253	Counter 0	310H
U6 8253	Counter 1	311H
U6 8253	Counter 2	312H
U6 8253	Control Reg	313H
U11 74HCT174	WDT & Counter Control	314H
U12 8255	Port A (WDT Counter)	318H
U12 8255	Port B Input	319H
U12 8255	Port C Output/Input	31AH
U12 8255	Control Word	31BH

TABLE 4
Settings for links LB1/LB2

Position	Frequency
1-2	25.6kHz
3-4	12.8kHz
5-6	6400Hz
6-7	3200Hz
8-9	1600Hz
10-11	800Hz
12-13	400Hz
14-15	200Hz

WDT operation

C and C++ seem to be the most popular languages in these times, so I have written the following examples in Borland C. But they can easily be adapted to other varieties of C or other languages. In the following examples and programs I have assumed your card occupies the prototype area 310 - 31B hex.

There are two modes of operation of the WDT. The first mode requires you to have access to the source code of the applications program, or to write a driver routine for the application to call. You can then directly address the watchdog timer by inserting instructions into your application.

When your program commences, you have to load the WDT with its timeout period. Let's say, for example, that the timeout period is 20 seconds. The output of U5 (74HCT4060) is a 200Hz signal, and U7 (74HCT4017) counts up to 10 before issuing a reset signal. Hence U6 (8253) must be loaded with the value 20*200/10=400, and the instructions would look like:

```
outportb(0x313,0x34);/* write the
                        control word */
countlowbyte=400%0x100;
counthighbyte=400/0x100;
outportb(0x310,countlowbyte); /*
  write to the 8253 at address 0x310 */
outportb(0x310,counthighbyte);
```

Next follows the instruction to bring

'Watchdog' Timer Card for PC's

the G0 line on the 8253 high to start the WDT:

outportb(0x314,0x01);

Now you have to periodically bring the G0 line on the 8253 low and then high to prevent the WDT from timing out:

outportb(0x314,0x00);
outportb(0x314,0x01);

All this is encompassed in the test program I have written, called TESTWDT.C (see Listing 1). When in operation you will see the LEDs sequentially light up. If you press a key this will cause the WDT to be pulsed and the LEDs start all over again. If you allow every LED to light up the WDT will time out and the computer will reset. Pressing the ESC key allows you to abort the program.

If your program or application can be exited normally to go to DOS, you will need to disarm the WDT. So just before leaving you would issue the instruction:

outportb(0x314,0x00);

The second mode is where the WDT is being prevented from timing out by the presence of a signal, such as from a serial or printer port. You firstly have to make a connection from the signal you are monitoring to pins 19 and 37 on connector J2.

Let us assume you are monitoring the Tx line of the serial port. You would make a connection from the pin 2 of the D25 connector (pin 3 for a D9 connector) to pin 37 of J2 and from pin 7 of the D25 connector (pin 5 for a D9 connector) to pin 19 of J2.

In order to use this mode I have written two programs. The first is WDTBOOT (Listing 2). It should be run just before your application runs. It is called with two variables, the first being the timeout period in tenths of seconds followed by the number of resets that you wish the card to carry out before stopping. If you enter 0 then it will not check the number of resets.

The following command, 'WDTBOOT 30 6' would load the watchdog timer with a timeout period of 30 seconds and would check to see that the number of resets since the last power on was not greater than six. The program also checks for the status of the 8255's C port and sets it accordingly.

If your program finished running normally you would call the program WDTEND which simply disarms the WDT by bringing G0 low (Listing 3).

TABLE 5
Settings for links LK4/LK5

I/O	IC	Control Word	LK4	LK5
Input	74HCT245	0x9b	3-4 closed	1-2 closed
Output	74HCT245	0x92	3-4 closed	1-2 open
Output	ULN2803	0x92	1-2 closed	1-2 open

Digital I/O operation

The card I/O is very easy to program. You first have to set up the 8255 in its correct configuration. The 8255 when reset has all its ports configured as inputs. The following routine reads the status of LK5 which determines if port C is to be configured as an input or output and then writes to the control register accordingly.

As an example I have produced the test program TEST8255.C which when a key is pressed will read Port A, Port B and output a byte on Port C. Before running the program check Table 4 for correct placement of your links.

TABLE 6
Settings for links LK1/LK2

Position	Effect
1-2	Software control of GATE1 via U11
3-4	External control of GATE1 via pin 30 J2
5-6	CLK1 connected to ACLK1 of U5
6-7	External clock to CLK1 via pin 12 J2
8-9	Software control of GATE2 via U11
10-11	External control of GATE2 via pin 32 J2
12-13	CLK2 connected to BCLK1 of U5
14-15	External clock to CLK2 via pin 14 J2

Counter/timer operation

The operation of a counter/timer is controlled by the control word that you write to the mode register of the counter. As was stated before there are six modes you can choose from. As an example of how to use the counter/timers I have written the simple program TEST8253.C which sets counter 1 up as a down pulse counter and counter 2 as a square wave generator.

Software control is used on GATES 1 and 2 (LK3 positions 1-2 and 9-10 closed and 3-4 and 11-12 open) and the clock sources are ACLK1 (200Hz LK1 position 1-2 closed and LK3 position 5-6 closed, 7-8 open) and BCLK2 (3200Hz LK2 position 7-8 closed and LK3 position 13-14 closed, 15-16 open).

Summary

Well, there it is. I hope this has given you an insight into the card's capabilities. Watchdog timers have been inserted into microcontrollers over the years to ensure their continuous operation. I would be the first to admit that PC's are quite a different environment to dedicated microcontrollers, but I believe that with this watchdog timer they can be a very cost-effective way of ensuring that your application runs continuously.

Incidentally the card can be ordered from my company Ocean Controls, of 4 Ferguson Drive, Balnarring Victoria 3926; phone (059) 83 1163. Fully completed and tested, the card costs $300; as a kit it is priced at $150.

Please note that I'm retaining commercial copyright to the PCB patterns and the software, so other companies are not free to market boards or kits for this project. However private individuals are free to build up their own boards, if they wish.

I'm allowing *EA* to make available the PCB patterns and software, for example as files on their BBS. ❖

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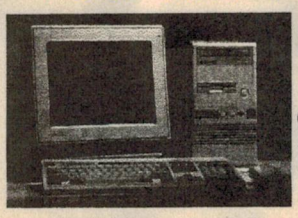
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QUEENSLAND INDUSTRY FEATURE:

Griffith Uni's IAP powers ahead

Now in its third year, Griffith University's innovative Industrial Affiliates Programme has proved a big success with both students and the University's industry partners. Final year undergraduate students in the School of Microelectronic Engineering have worked with the State's industry on 40 important R&D projects during 1995.

The School's Industrial Affiliates Programme (IAP) is designed to link the resources of the University with those of industry, to assist both the development of Queensland technology and the education of electronics engineering students. Professor Barry Harrison, Head of the School, said the programme provided final year students with valuable experience as well as an understanding of commercial operations. Industry partners also gained significantly through the efforts of students in R&D.

"The diversity and commercial and social importance of projects undertaken in 1995 reflects the high standards and outcomes of the Programme", he said. "Involvement in the Programme generally provides industry with a low cost solution and an innovative outcome."

"Through the Programme, the School of Microelectronic Engineering is improving the skills of Queensland's new generation of microelectronics engineers, and playing a part in the growth of an important industry."

Among the projects carried out under the 1995 Programme were preliminary research at the Queensland State Library, for a project to digitise some 20,000 historical photographs for a CD-ROM; development of a remote monitoring and control system for Queensland's only stereolithography facility; design of a video controller for use in laparoscopic surgery; and an investigation of the use of thermography by a new player in the State's power industry.



QR Operational Systems Manager Kim Kjaer-Olsen, IAP Student Bill Sullivan and QR Signal & Systems Engineer Michael Scheck.

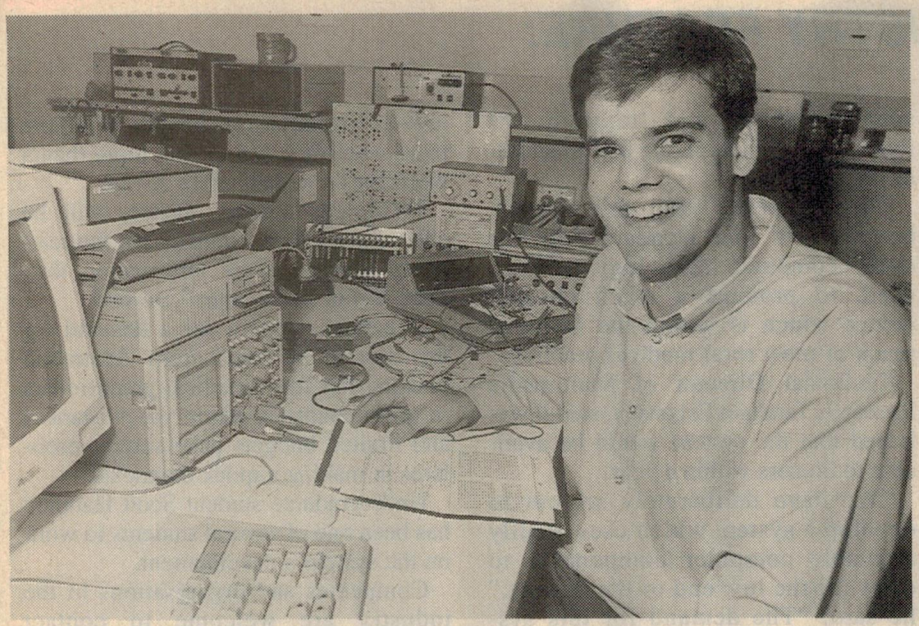
Railway projects

Two other research projects were carried out in a partnership with Queensland Rail (QR), to upgrade railway technology in Queensland. Undergraduate students Bill Sullivan and Brett Parker were placed with QR as part of the IAP, and were involved in the initial stages of research to develop an improved level crossing warning system and a more portable and reliable telemetry testing unit.

According to Mark Roome, Manager of QR Signal and Operational Systems, the development of a 'user friendly' telemetry testing unit will have major benefits for technicians working in remote areas of the State.

Telemetry is fundamental to remote control signalling on railway lines across Queensland, sending information on the status of signalling equipment from the site back to key control centres. Currently, technicians sent to test telemetry use a bulky 'hard wired' unit which can require two people to handle and relies largely on the skills of the operator.

"We believe we can develop a system which is portable yet of industrial strength, and can provide quality testing," Mark said. "The first phase of the project, carried out under the IAP involved designing, writing the software and proving the concept. The second phase will involve development and testing, which should be completed within three years."



IAP student Daren Threadingham works on Australia Post's new letter counter.

Mark said that as well as application by Queensland Rail, the improved technology could be sold to interstate and overseas rail authorities and other users of telemetry such as gas pipeline operators and water authorities.

Signal Systems Engineer with QR, George Nikandros, said a detailed reliability analysis and failure modes and effects analysis were carried out under the IAP on a level crossing warning system also being developed by QR. The new system plans to replace electronic components with new technology, allowing improved performance of flashing lights at level rail crossings.

Post office project

Another IAP project, carried out in partnership with Australia Post, was to develop a faster, simpler, cheaper and more accurate handheld letter counter.

Leading on from initial development work by a former student, undergraduate Daren Threadingham concentrated this year on completing the prototype and resolving initial problems relating to the counter's ability to work effectively at varying distances.

Technical Supervisor and Acting Senior Engineer of the Development Laboratory, Jeff Callow, said there was widespread interest in the handheld

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counter by several areas within Australia Post. He said the counter had the potential to significantly streamline bulk mail handling, as well as provide ease of handling and greater accuracy with slimmer envelopes.

Currently, Australia Post checks that customers are charged correctly for their bulk mail by using a stationary flat tray with a sensor which detects edges of letters as they are swept across.

The bar code reader developed under the IAP uses a laser to provide a reflection off the letter's edges as it passes across the top of the letter stack.

Helping rural doctors

Yet another IAP project, carried out in conjunction with Multimedia Research, is designed to help medical practices in rural areas by developing a teleradiography system which uses standard IBM compatible computer equipment.

Like other teleradiography systems on the market, this system captures X-ray and ultrasound images on a personal computer and transmits the images via the telephone line to another computer.

The difference with this system, however, is that standard 'off the shelf' computer technology is being used, to produce a much cheaper device which is within the financial reach of most rural medical practices.

Technical Director of Multimedia Research, Graham Eshensky, said it was hoped that the system would be available to doctors within a year.

"We have deliberately set out to develop a system which uses readily available computer components to cater for the low end of the market," he said. "The demand for this system and the interest in its development is enormous.''

Lecturer in Microelectronic Engineering at Griffith University and Head of the University's Signal Processing and Intelligent Systems Research Laboratory, Mr Suresh Hungenahally, said the system was a low-cost solution for doctors in remote areas who often had to wait more than a week for the results of an X-ray.

"With this system, doctors will be able to send X-ray images via the telephone and have the information they need within a few hours", he said.

"I believe we will see a demand for this system not only from Australian doctors, but from medical practitioners in other countries where vast distances and limited budgets pose similar problems in making a quick diagnosis."

Undergraduate student Scott Handley has been one of several students to work on the system's development.

Companies and organisations in the industry are welcome to contact Griffith University's School of Microelectronic Engineering, to discuss how participation in the Industrial Affiliates Programme can benefit them. The contact person is programme manager Carol-joy Patrick, phone (07) 3875 5007 or fax (07) 3875 6726. ❖

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QUEENSLAND INDUSTRY FEATURE:

PRODUCTS & SERVICES

Here's just a sampling of the wide range of electronics products and services currently being offered by Queensland-based manufacturers, distributors and dealers...

'Smart' filter range launched

Brisbane-based power filtering and conditioning specialist Precision Power has developed a range of 'smart' filters. Precision Power's national sales manager John Wedgwood says the filters are 'smarter' and faster than similar products, and are designed to remove all of the electrical problems associated with 'dirty' power in an industrial environment.

"The product we have developed is world class, and can be used in conjunction with world class machinery. It is cost effective, has a five year warranty and is ideal for any type of power supply."

The company recently established a joint venture in Thailand to manufacture the filters under licence. "We are very happy we can export our knowledge and products to Asia", said Mr Wedgwood. "Thailand began manufacturing early this year, and we expect to sell more than $250,000 worth of filters in the first year."

20MHz DSO, system supplies

L.E. Boughen and Co has available the Topward 9020 Digital Storage Oscilloscope, which features 40MS/s sampling in storage mode and an analog bandwidth of 20MHz. The maximum vertical input sensitivity is 5mV/div, with an accuracy of +/-3%.

Horizontal resolution is 200 points/div on all ranges except 2us/div, where it is 80 points/div.

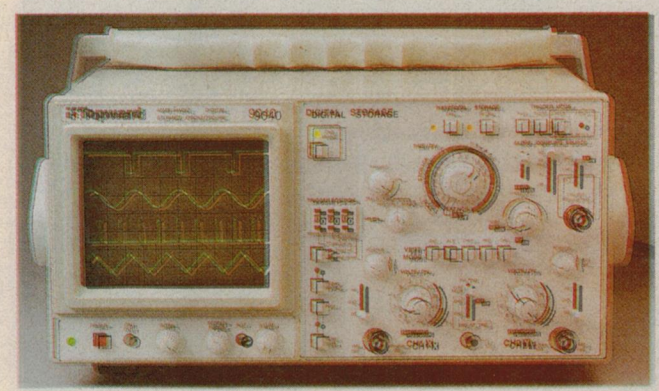
Features of the instrument include pre- and post-triggering, waveform save and recall, plus an RS-232C serial port for sending waveform data to a computer. The DSO measures 314 x 165 x 524mm and weighs 10kg approx. Optional waveform processing software is also available.

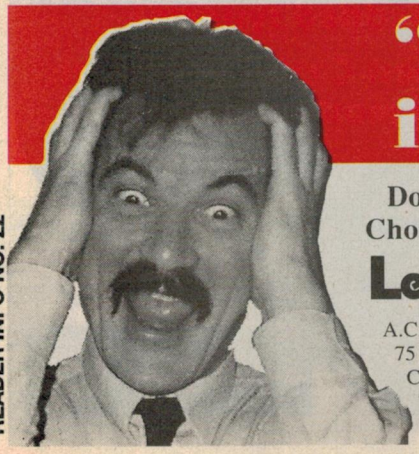
The Topward 6000 series of system power supplies are also now available, with dual 0-30V DC outputs rated at 0-3A and a fixed 5V DC output rated at 0-5A. The supplies provide four output V/I displays, and models are available with either analog or digital readout.

Features of the displays include constant voltage/current operation, the ability to be used in series or parallel combinations, protection against both short circuits and external input, selectable master/slave operation, and output voltage/current programmable using an external variable voltage or resistance.

The Topward Series 3000 system power supply is also available, with outputs of 0-30V or 0-60V at 0-10A, and either dual analog or dual digital displays.

For further information contact L.E. Boughen at 33 Railway Terrace, Milton 4064; phone (07) 3369 1277 or fax (07) 3368 3193.





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QUEENSLAND INDUSTRY FEATURE:

The company's filters range in price from $300 for the home market to $15,000 for the industrial market, and are available from most electrical suppliers. Precision Power developed the filters with assistance from the Department of Business, Industry and Regional Development (DBIRD), and also received a subsidy under the Queensland Grants for Industrial Research and Development.

Precision Power employs 20 people and was established by electrical contractor Jim Westwood who has nearly 20 years experience in the industry.

Further information is available from Precision Power at 12 The Corso, Norman Park 4170; phone (07) 3395 7433, or fax (07) 3395 6650.

GMDSS approved 'survival radio'

Delsound now has available the new Icom IC-GM1500, a VHF marine handheld transceiver, approved for use at sea for survival purposes by the Global Maritime Distress and Safety System (GMDSS). Ocean-going cargo vessels between 300 and 500 gross tons are required to carry a minimum of two radios, stowed in the survival craft on board, while cargo vessels over 500 gross tons or passenger ships must carry a minimum of three such radios.

To qualify for GMDSS approval, the IC-GM1500 is water proof at one metre deep for at least five minutes, and drop resistant from one metre onto any surface. The optional non-rechargeable lithium survival battery pack provides eight hours use at a 10tx:10rx:80 standby ratio, while the rechargeable NiCad battery pack supplied with the radio is ideal for general use.

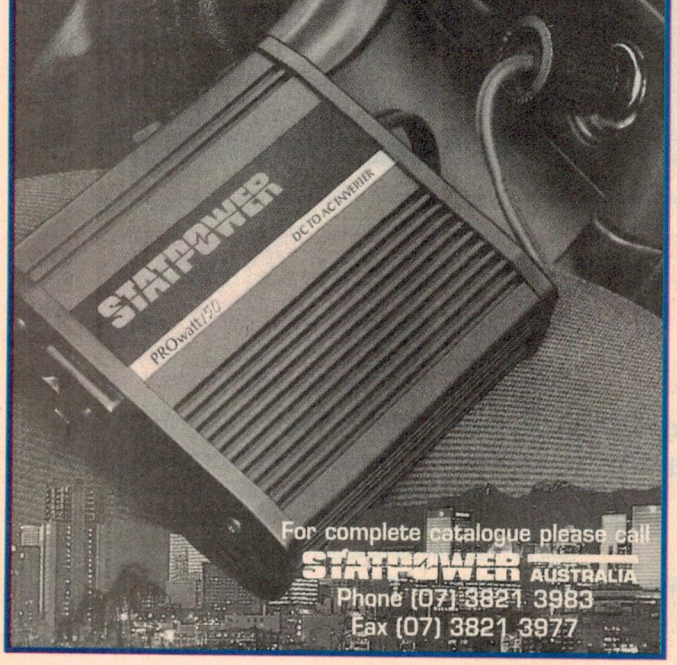
Icom has designed the radio to be as simple to use as possible under extreme conditions, with tactile feedback on all keys and instant access to emergency channel 16. All 55 marine VHF channels are accessible via a rotary tuning knob, which automatically resets to channel 16 if the power is turned off.

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For further information on the

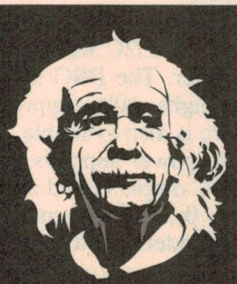
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Diagnostic tools for PCs

Brisbane based company Objectives has recently been appointed Australian master distributor for the AllMicro range of computer diagnostics and repair tools. The products in the AllMicro range include:

The Alert Card — which constantly checks or monitors the power supply status and temperature of stand-alone PCs or network servers, and alerts immediately if either should move outside a safe range.

The Discovery Card — which reliably detects usage of IRQ or DMA channels

LAN Designer — which automates the design and installation of the most complex network, ensuring trouble-free installation regardless of the size and complexity of the site and any special problems which may exist.

Skylight — which troubleshoots Windows to ensure correct configuration and optimum performance.

Rescue — best selling product in the range, designed to allow retrieval of data from damaged disks or hard drives, regardless of format. Rescue is available in both retail and professional versions, and safely recovers all file types from compressed drives. It can also retrieve data from Windows NT, LANtastic and NetWare Lite formats, and is claimed to be fully compatible with Windows 95.

Further information is available from Objectives at 1 Bellambi Place, Westlake 4074; phone (07) 3279 5551, or fax (07) 3279 4494.

Qld distributor for Tektronix

Leading Queensland-based component, tool and component distributor St Lucia Electronics has recently been appointed as the Queensland distributor for the Tektronix range of test equipment.

The company has branches in Southport (Southport Electronic Shop) and in Flemington, Sydney NSW (Prime Electronic Components), and is committed to keeping high stock levels of its 60,000-plus line items.

Further information is available from St Lucia Electronics, at 24 Campbell Street, Bowen Hills 4006; phone (07) 3252 7466 or fax (07) 3252 2862. ❖

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Heater: Ceramic with Embedded RTD Supplied with S9-305S High Mass Soldering Tip
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READER INFO NO. 26

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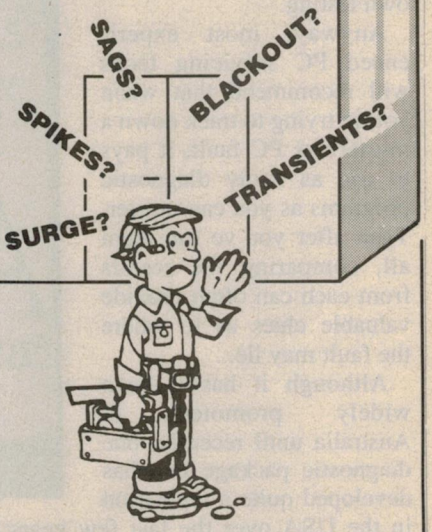


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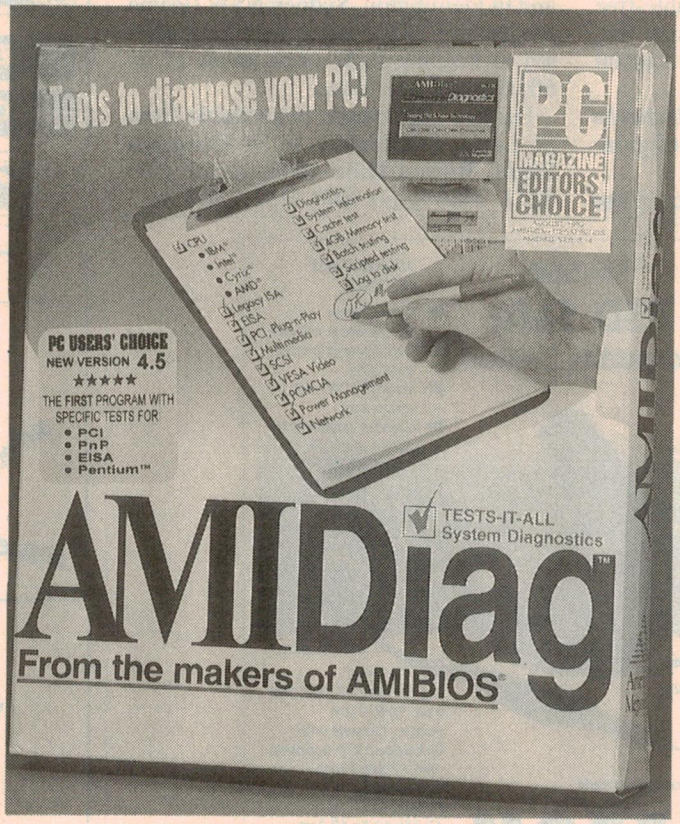
Now available from Qld distributor:

AMIDIAG V4.50 DIAGNOSTIC SOFTWARE

Diagnostic software can be very handy when you're trying to track down elusive computer faults. One of the packages that's becoming very popular is AMIDiag, from American Megatrends — one of the 'big three' BIOS firms. The latest version of AMIDiag has specific tests for PCI and EISA, Plug-n-Play and Pentium processors, along with the ability to test up to 4GB of RAM and exactly how much cache RAM is actually functioning.

by JIM ROWE

It's become something of a PC-industry axiom that you can never have too many diagnostic programs. That seems to be because many of these programs seem to have their own particular weak areas, as well as their strengths. Some also seem to offer inaccurate reporting in certain areas of system operation, and there's a suggestion that some may simply read the system's setup data rather than actually do their own testing.



Anyway, most experienced PC servicing techs will recommend that when you're trying to track down a mysterious PC fault, it pays to use as many diagnostic programs as you can muster. Then after you've run them all, comparing the results from each can often provide valuable clues as to where the fault may lie...

Although it hasn't been widely promoted in Australia until recently, one diagnostic package that has developed quite a reputation in the USA over the last few years is AMIDiag. This comes from American Megatrends Inc. or 'AMI', whose BIOS is used in many of the IBM compatibles. In fact they're one of the 'big three' BIOS firms, along with Pheonix and Award.

Needless to say, with the intimate knowledge of PC operation required to produce a BIOS, AMI software engineers were also in an excellent position to produce a good diagnostic package. And this certainly seems to have been the result, because AMIDiag has won a string of awards — including, for example a *PC Magazine* Editor's Choice Award in August 1990 (version 3.14). More recently it was given top ranking by the US National Association of Computer Consultants and Resellers.

Quite apart from its use by installation and servicing people, AMIDiag has also become widely used by computer manufacturers themselves for final testing. This is quite an endorsement, and some of the features that AMI has added for the more recent versions were actually at the request of manufacturers and professional servicing firms.

The latest version of the package is AMIDiag 4.50, released late last year and incorporating features to cope with the latest 'bells and whistles' in the ongoing saga of PC hardware evolution. For example version 4.50 is apparently the first diagnostic program to include specific tests for the PCI local bus, the new Plug-n-Play expansion system and the latest Pentium chips. Other new features include full EISA bus and SCSI port/controller testing, thorough IRQ and DMA channel assignment reporting and testing (including PCI usage), and the ability to reliably report on and comprehensively test main memory up to 4GB.

The new features are in addition to the many existing tests and facilities which have made the package so highly regarded. These include a really reliable test for *functioning* cache memory (both level 1 and level 2), up to a total of 16MB; the ability to detect and test any of the Intel 80x86 processors, the Pentium and P54C processors, and all of the main processors from IBM, Cyrix and AMD; extensive functional

testing of ISA, EISA and PCI motherboards; complete testing of VESA video memory and display modes; testing of COM ports up to 115.2kb/s; thorough hard disk testing, including testing for optimum interleave; testing of all standard floppy disk drives, including the 2.88MB type; speaker and sound card testing (even without drivers); and keyboards and mouse testing.

Actually the complete AMIDiag 4.50 package includes not only AMIDiag itself, but three other programs as well: Sysinfo, a very thorough system hardware and software reporting program; a virus scanning program called AMU — short for Anti-viral Maintenance Utility; and CONFIG.EXE, which creates and maintains a database of test configurations, motherboards, cache controllers and user programs.

It's actually Sysinfo that is used to investigate your system and provide all the important and detailed information on things like memory and I/O address usage, IDE drive configuration, interrupt and DMA channel usage, SCSI device addressing and so on. Sysinfo can even report on PCMCIA card details, the power management setup, CMOS setup RAM contents, the contents of CONFIG.SYS, AUTOEXEC.BAT, WIN.INI and SYSTEM.INI, a listing of the installed device drivers and so on.

Also included in the AMIDiag 4.50 package are a pair of loop-back connectors for I/O port testing (a DB25 male connector for printer ports, and a DB9 female for COM ports), and a very detailed 184-page User Manual. This has clear information on each test and reporting function, how to run it properly and the exact significance of every possible result and error code...

Incidentally both AMIDiag and Sysinfo have a built-in help facility. AMIDiag can also be arranged to perform batch testing, with the test results saved automatically in a file for printing out later as a test report. Similarly Sysinfo can be arranged to print out system information, either on an individual 'screen print' basis or as a full report by setting it to 'check everything and print the result'.

There's even a facility for getting AMIDiag to run additional test programs written by the user or a third party. These can be run together with AMIDiag's own tests, and the results integrated for a final report. And CONFIG.EXE can even be arranged to display graphical information (a PCX file) on-screen in response to various test results — so that semi-technical production people can be provided with a 'picture' showing the exact location of a faulty chip or other component. Very impressive!

Trying it out

We tried out the new AMIDiag 4.50 package with a variety of machines, ranging from an elderly AT clone right up to a current-model 90MHz Pentium machine with 16MB RAM, 512KB L2 cache, PCI bus video and SCSI adaptors, dual IDE hard drives plus CD-ROM (IDE) and a sound card. In each case we found that it provided very detailed information, and performed many tests that had previously required firing up a number of other programs.

All of the hardware configuration information delivered by Sysinfo agreed closely with the actual configurations on the machines concerned, while the test results from AMIDiag either agreed with the consensus of other diagnostic tools, or gave every evidence of being more accurate.

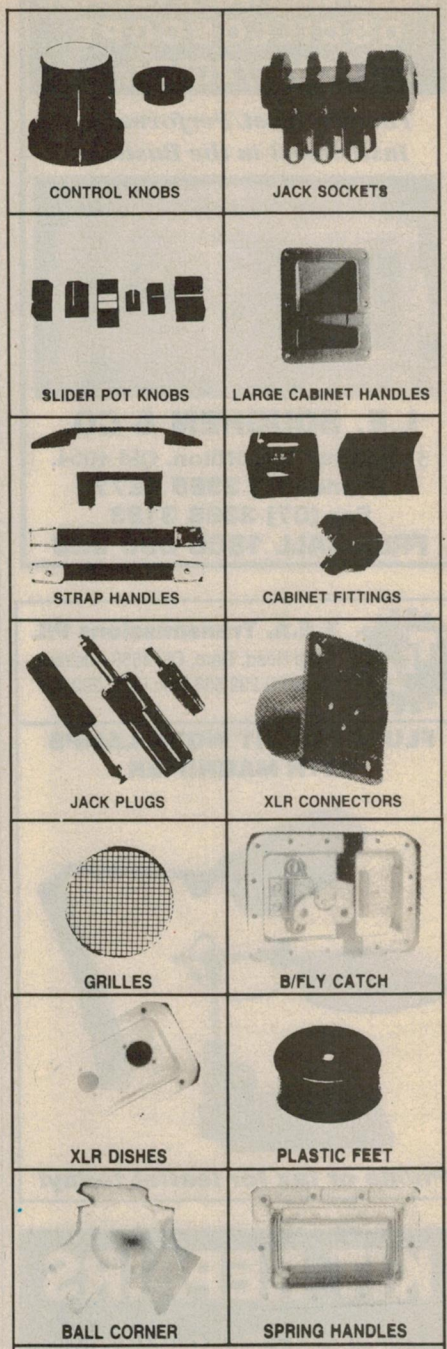
About the only thing we didn't seem to be able to achieve was getting Sysinfo to pin down the I/O address and interrupt line/DMA channel used by the software-configured Ethernet network adaptor cards in our office machines, hooked up to the company's network running Novell Netware 3.12. Although Sysinfo would tell us details about the network and server, and that the drivers IPX and NETX were installed and in use, it didn't seem to find the adaptor card itself. Still, none of our other diagnostic packages seemed to be able to do this, either!

By the way, AMIDiag 4.50 is only suitable for faultfinding in machines using the 80286 or later processors. So if you need to repair an old 8088/8086-based PC or XT, it isn't suitable.

Overall, though, the AMIDiag diagnostic package in its latest form seems to us a particularly thorough and comprehensive one, capable of providing a huge amount of detailed and valuable information. If you're involved in fixing sick PCs, it would be a very worthwhile addition to your armory of diagnostic tools.

At the quoted price of $159, it also seems to represent excellent value for money.

It's available from Australian distributor Tech Star International, of PO Box 259, Paddington Qld 4064; phone (07) 3367 1444, or fax (07) 3367 1331. ❖



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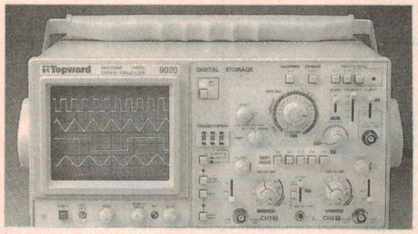
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QUEENSLAND INDUSTRY FEATURE:

Listing of Suppliers and Manufacturers

To assist our readers in identifying, locating and contacting suppliers and manufacturers based in Queensland, here is a listing showing each firm's address and contact details plus a summary of their main products and services:

Bainbridge Marine

2/77 Shore Street, Cleveland 4163. Phone (07) 3821 3333, fax (07) 3821 3977. Contact: Ron Heindorf.

Suppliers of the latest technology, highly efficient and lightweight Statpower range of 12/24V to 240V AC inverters and Truecharge range of battery chargers.

Baltec Systems

PO Box 107, Paddington 4064. Phone (07) 3369 5900, fax (07) 3369 5257. Contact: Stephen Gabb.

Distributors of industrial workstations and PC's, load cells, data acquisition and control boards. Also electronic development tools such as in-circuit emulators, multi-tasking real time kernels, cross compilers, assemblers, RAM/ROM emulators and device programmers.

Campad Electronics

PO Box 269, Capalaba, 4157. Phone (07) 3245 2008. Contact: Chris Alick.

Services include R&D for industrial electronics; protection of pool, spa and irrigation pumps; power supplies (both linear and switch mode); servicing and repair of electronic equipment and kits.

Cliff Electronics (Aust)

34c Chester Street (PO Box 732), Fortitude Valley 4006. Phone (07) 3252 3178, fax (07) 3252 3165. Contact: Paul Montague.

Specialises in electronic hardware and test equipment. Hardware products include connectors, control knobs, 19" rack hardware, cabinet and flight case hardware. Instruments include Fluke, Black Star, Deltaohm, Pantee, Kepco and AEMC.

Delsound

1 Wickham Terrace (cnr Ann and Wharf Sts), Brisbane 4000. Phone (07) 3839 6155, fax (07) 3832 5278. Contact: Dave Cribbis.

Supplier of electronic components, communications equipment, computer accessories and PA equipment. Established in 1971, now offers over 15,000 product lines. TOA Distributor plus other brands include H-P, Cherry, Swann, Arista and Altronics.

ECQ Electronics

236 Arthur Street, Newstead 4006. Phone (07) 3254 1153, fax (07) 3254 1391. Contact: Mike Senescall.

Supplier of electronic components, tools, soldering and desoldering equipment, surface mount rework equipment, data communications products, cables and connectors, power supplies, EPROM programmer and erasers.

Griffith University Professional Courses

School of Microelectronic Engineering, Faculty of Science & Technology, Griffith University 4111. Phone (07) 3875 5007, fax (07) 3875 6726. Contact: Carol-joy Patrick.

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Hi-Tech Software

41 Yarrabee Street, The Gap 4051. Phone (07) 3300 5011, fax (07) 3300 5245. Contact: Clyde Smith-Stubbs.

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Jacques Electronics

268 Montague Road, West End 4101. Phone (07) 3844 1103, fax (07) 3844 1078. Contact: Stan Jacques or Hock Goh.

Designs and manufactures high quality audio, video, intercoms and a comprehensive range of 19" equipment racks and accessories. Products include digital intercom systems, audio and video switchers and distribution amplifiers, power amplifiers and a comprehensive range of audio and video equipment.

Kyle Communications

Contact: Mark Kyle. Phone (07) 3857 4400, fax (07) 3857 7825.

Specialises in satellite TV & Communications, all types of radio comms sales and service. Also designs and manufactures RF projects from start to finish.

L.E. Boughen

33 Railway Terrace, Milton 4064 (PO Box 136, Toowong 4066). Phone (07) 3369 1277, fax (07) 3368 3193. Contact: Robin Boughen.

Industrial electronics sales, covering test and measuring equipment, components, data acquisition and audio/visual equipment. Importers of Topward instruments, Myoung instruments, Axiom industrial PCs and boards, and Teknor single board computers.

Leprechaun Software

1/75 Redland Bay Road, Capalaba 4157. Phone (07) 3823 1300, fax (07) 3823 1233. Contact: Cheryl Underwood.

An Australian company specialising in anti-virus software. Its Virus Buster products have received worldwide acclaim. Staff assist clients in identifying rogue code and restoring unprotected systems, and also consult on virus security strategies.

Nationwide Antenna Systems

17 Campbell Street, Bowen Hills 4006. Phone (07) 3252 2947, fax (07) 3252 8541. Contact: Geoff Dargie.

Manufacturer and supplier of TV antennas, accessories and signal distribution systems, including satellite receiving systems. 21 years experience in both domestic and commercial systems.

Objectives

1 Bellambi Place, Westlake, 4074. Phone (07) 3279 5551, fax (07) 3279 4494. Contact: Lorraine Cobcroft.

Markets and supports the Layout range of advanced object-orientated development tools, for the easy creation of fast and compact EXE programmes for DOS or Windows.

Precision Power

No.12 The Corso, Norman Park 4170. Phone (07) 3395 7433, fax (07) 3395 6650. Contact: John Wedgewood.

Manufacturer and importer of products to overcome power-induced problems, incorporating the 'Islatrol' active tracking suppressor range of filters. Provides filters, power conditioners and UPS to 6kVA rating, exporting to Asia and the Pacific.

St Lucia Electronics

24 Campbell Street, Bowen Hills, 4006. Phone (07) 3252 7466, fax (07) 3252 2862. Branches also in Bowen Hills (22 Campbell Street) and Southport (Brickworks Complex). Contact: Peter Goleby.

Leading wholesale, trade and retail supplier of a wide range of electronic components, test instruments, equipment and tools. Recently appointed distributor of Tektronix test equipment.

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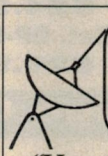
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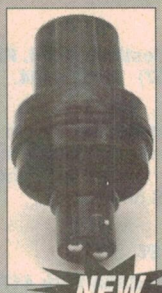
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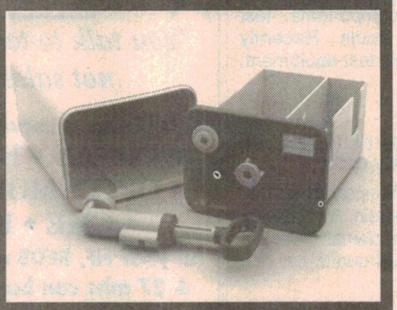
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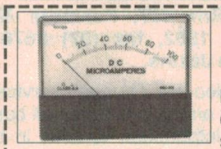
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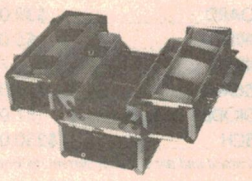
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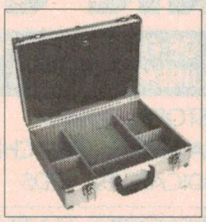
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Cat. HB-6350 **$89.50**

#2 - ECONOMY ATTACHE



This case is more like your typical aluminium servicemans case. It is all silver and is supplied with a tool pallet which sits in the lid and will hold an assortment of tools. The case is padded and is lockable and supplied with 2 keys. Size: 450(W) x 320(H) x 145(D)mm.

Cat HB-6352 **$59.50**

#3 - DELUXE ATTACHE



This case looks smart. Its made from black anodised aluminium and has slightly padded sides. Inside is padded. Size: 450(W) x 320(H) x 145(D)mm.

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AA NiCad Sensation



550mA / Hr. **Cat. SB-2452**

4 for $7.95 Save $2.05

BUY 10 LESS 10%

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326 Newcastle St
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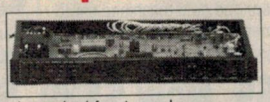
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KIT SPECIALS FROM JAYCAR

"Blue Print" Remote Control Preamp Kit



REF SC Sept/Oct/Nov 1993 - For full specs see 1995 cat. Includes all components, PCB, chasis, fully screened and punched front panel.

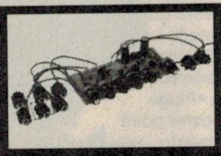
Cat. KC-5142

Normally $449

Now $399 Save $50

Pre programmed Remote Control To Suit Cat KC-5141 $89.95

Versatile Guitar Preamplifier Kit



REF ETI November 1987. Kit is supplied with PCB and all components. **Cat. KE-4729**

Normally $45 Now $29.95 Save $15

4 Digit 50MHz Frequency Counter Kit



REF EA Feb 1993. Includes: professionally punched and silkscreened front panel and all specified components. Complete set of IC sockets and red perspex display lens supplied for no extra cost.

Cat. KA-1749

Normally $99.50

Now $79.50 Save $20

Use our MP-3006 12VDC 450mA plugpack to suit $15.50

Digital Voice Recorder Kit

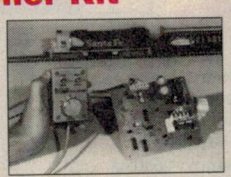


REF SC Dec 1993. You can record your own voice, sound or music and connect it to your computer. Kit includes PCB and all components, speaker mic insert. Box not included. Requires our MP-3006 12VDC 450mA plug pack to suit $15.50. **Cat. KC-5072**

Normally $79.50

Now $65 Save $14.50

Train Controller Kit



REF SC April/May 1988. For full details see page 23 of 1995 catalogue. Kit includes PCB, mains transformer, case and panel for walk around throttle, aluminium panel and all specified components.

Cat. KC-5028

Norm $89 Now $69 Save $20

JAYCAR - NO. 1 FOR KITS

40V 3A LCD Variable Power Supply

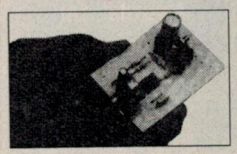


REF SC Jan/Feb 1994. Adjustable from 1.23V to 40V. Kit is supplied full form. ie Case, LCD, punched and screened front panel, PCB, plus all specified components. **Cat. KC-5147**

Normally $239

Now $199 Save $40

Low Voltage DC Speed Controller Kit



REF SC Jan 1994. Suits PCB drills and 12V lights. Kit includes PCB and all specified electronic components.

Cat. KC-5146

Normally $14.95

Now $9.95 Save $5

Cable Checker Kit



REF EA Nov 1994. This handy checker will show you the conditions of a cable instantly by illuminating one or more LEDs. This checker is much easier and faster than a continuity tester or multimeter. Kit includes case, PCB, silkscreened front panel, BNC and RCA sockets, plus all specified components. 9V battery required - use cat SB-2370.

Cat. KA-1766

Normally $22.95

Now $17.95 Save $5

Single Cell Nicad Discharger Kit

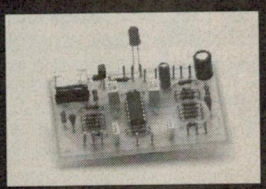


REF SC May 1993. No external power to operate which makes this kit fully portable and extremely easy to use. Complete with PCB, case, all components plus front panel and label. Cell holder kit not included. **Cat. KC-5132**

Normally $27.95

Now $19.95 Save $8

Universal Voice Operated Relay Kit



REF EA November 1987. For details please refer page 16 of our 1995 catalogue. Short form kit includes PCB and all components. **Cat. KA-1692**

Normally $24.95

Now $17.95 Save $7

VADER Voice Kit

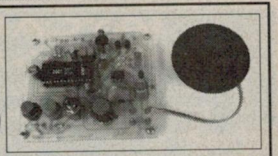


REF SC 1988. You can sound like Darth Vader or a number of other diobolical characters from the nether regions of the galaxy. Kit includes jiffy box, mic insert, speaker and all components. **Cat. KC-5039**

Normally $19.95

Now $14.95 Save $5

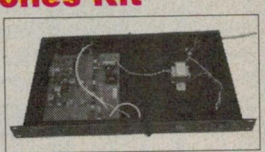
90 Second Message Recorder Kit



REF SC Feb 1994. 90 seconds of continuous record time. Kit includes PCB, isostat switches, storage IC plus all specified components **Cat. KC-5151**

Normally $89 Now $59 Save $30

Dual Diversity Tuner For FM Microphones Kit



REF SC Aug/Sept 1994. Save hundreds over commercial units. For more information and specifications please refer to page 19 of our 1995 catalogue. Kit includes PCB, mains transformer, hardware, switches, RCA and PAL sockets plus all specified electronic components. Case is not included. **Cat. KC-5170**

Normally $199 Now $149 Save $50

Talking Headlight Reminder Kit



REF SC October 1994. "Record Your Own Message". The kit is 100% complete with case, PCB, speaker, front panel, auto connectors plus cable and all specified electronic components, we'll even throw in a machined IC socket for the digital recorder IC. **Cat. KC-5173**

Normally $59.95

Now $44.95 Save $15

Radfax Decoder Kit



REF SC November 1989. For further information please see page 24 of our 1995 catalogue. Kit includes PCB, front panel, box and all specified components except D plug. Requires 12VAC plug pack cat MP-3020 $16.95.

Cat. KC-5059

Normally $44.95

Now $34.95

Save $10

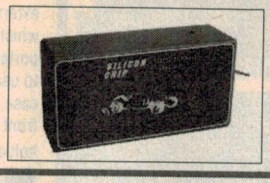
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MORE KIT SPECIALS FROM JAYCAR

Oil Change Timer For Cars Kit

REF SC Feb 1995. Can't remember when you last changed your oil! Well, this handy kit will remind you. Kit is supplied short form with buzzer, PCB and all electronic components. **Cat. KC-5180**



Normally $17.95

Now $12.95 Save $5

Digital Effects Unit For Musicians Kit



REF SC Feb 1995. For full details refer page 24 of Jaycar 1995 catalogue. Kit includes sloping case, professionally punched and sik screened front panel, PCBs, preprogrammed microprocessor and gold machined pin IC sockets, phono sockets, 1% metal film resistors and mkt capacitors. Requires 12VAC 300mA plug pack. Use MP-3020 $16.95. **Cat. KC-5179**

Normally $169 Now $139 Save $30

NOISEBUSTER

Personal Active Noise Reduction Headphones

As seen on Beyond 2000

1994 winner "The Discover Awards" for technological innovation

NEW

THESE HEADPHONES ARE AMAZING!!! They not only produce good quality audio sound like normal headphones, they REDUCE outside noise.

HOW DO THEY WORK?

The stereo headset features two microphones that continuously sample background noise. The data is fed into a high speed processing chip, which signals the headsets speakers to generate noise thats the exact mirror image of the offending waveform. The two waveforms cancel each other out. They are designed to cancel the most irritating monotonous drones, from lawn mowers and leaf blowers to aeroplanes and truck engines to air conditioners and computer fans etc.



And because the NOISEBUSTER is tuned to erase only sounds in the 30-1200Hz range, you can still clearly hear voices and sounds around you. For example - in aircraft, they will eliminate up to 95% of cabin noise, and you can listen to the movie or radio programs. Use with or without music.

HOW EFFECTIVE IS NOISEBUSTER AGAINST SPECIFIC NOISE?

•Aircraft cabin noise: up to 95% reduction •Automobile: up to 80% reduction •Train/subway: up to 70% reduction •Lawn mower: up to 60% reduction

The best way to convince yourself how good these really are - is to call in to any Jaycar store and try them! You will be as amazed as we were!

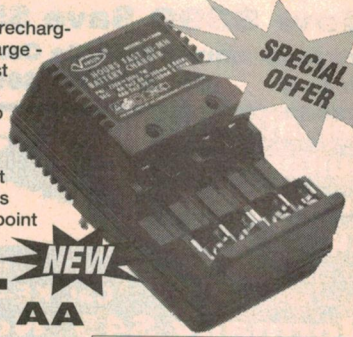
Cat. AA-2000 **ONLY $149**

Jaytech Fast Ni-MH Battery Charger

Features:

•Charges 2 or 4 pcs AA or AAA rechargeable Ni-MH batteries •Fast charge - 5 hours •LED lamp indicates fast charge and trickle charge •Built in safety temperature sensors to avoid the battery from damage by overheating •Built in IC timer control •Auto selects the correct charge rate for AA or AAA •Plugs directly into 240V mains power point •Electricity authority approved.

SPECIAL OFFER



Cat MB-3509 $39.95 NEW

1.1A NI-MH AA BATTERIES



$5.95ea Cat. SB-2455

Buy the MB-3509 charger and 8 x SB2455 batteries for only $79.95. SAVE $7.60

DOLBY PRO LOGIC KIT FOR UNDER $200!!

DOLBY SURROUND PRO • LOGIC

Yes, you can now buy the Dolby Pro Logic short form kit (KC-5175) and the enclosure kit (KC-5176) for $199.



SAVE $40 **$199**

DOLBY PRO LOGIC CENTRE SPEAKER KIT BARGAIN



Kit includes:

•2 x 5" shielded woofers Cat CW-2102	Value $79.90
•1 x 1" shielded dome tweeter Cat CW-2006	$16.95
•1 x crossover network Cat CX-2613	$8.50
•1 x set box plans / wiring details	$105.35

Only $89 SAVE OVER $16 Cat. CS-2500

JAYCAR WHOLESALE

Check us out for amazing prices for quality purchases of:

- •Plug Packs
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- •Wire
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- •Boxes
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- •Alarms
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- •Fans

AND MORE

PHONE: (02) 743 5222 FAX: (02) 743 3070

CAR REVERSE LIGHT BULB WITH BEEPER



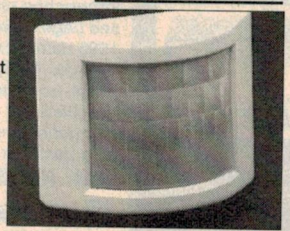
What a great idea! You simply take out one of your reversing globes and replace it with this. Its the same size as a normal globe, yet incorporates a 20W halogen lamp and a beeper. Allows everybody around you know instantly that you are reversing. You could save a serious accident for $20 and 5 minutes of your time.

Cat. SL-2850

only$19.95

Jaytech Advanced Pulse Count PIR

AMAZING QUALITY FOR UNDER $30. Features Advanced Pulse Count - the latest in PIR's which virtually eleminates false alarms. •small size •SMT •supplied with bracket •shielded relay •lenses available

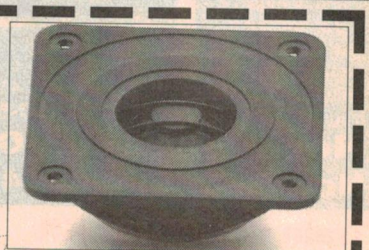


Only $29.95

Cat. LA-5025

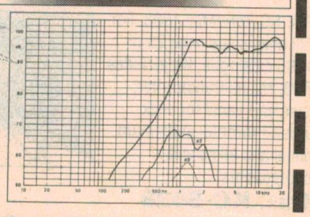
Wide angle lens	**Cat LA-5026**	**Only $3.95**
Curtain / pet lens	**Cat LA-5027**	**Only $3.95**
Hall / long range	**Cat LA-5028**	**Only $3.95**

PHILIPS DOME TWEETER DISTRESS PURCHASE!!!



YOUR CHANCE TO SAVE $$$. We've made a scoop purchase of some Philips AD11400/T8 1" Hi Fi Dome Tweeters. These are physically slightly smaller than our standard AD11610 tweeters but cost exactly the same price to buy from Philips. Grab some while we have them.

SAVE A FORTUNE



Specifications: •Impedance: 8Ω •Voice coil resistance: 6.3Ω •Resonant frequency: 1500Hz •System power handling: 100WRMS •SPL: 90dB/1m •Voice coil diameter: 25mm •Magnet weight: 100g •Size: 82 x 82mm, cutout hole 73mm

Cat. CT-2014 NORMAL PRICE IS AROUND $26

THIS LOT ONLY $16.95ea or 10 FOR $139

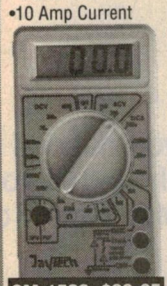
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AMAZING VALUE DMM'S FROM JAYCAR

BRILLIANT RANGE OF MULTIMETERS ALL OFFER UNBELEIVABLE VALUE FOR MONEY
For full specifications and list of all the features associated with each model see our 1995 catalogue.

Low Cost
- 3.5 Digit 12.5mm High Display LCD
- Transistor Test
- Diode Test
- 10 Amp Current



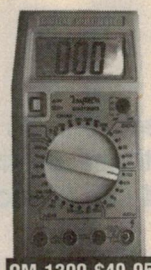
QM-1500 $29.95

Pocket
- 3.5 Digit
- Wrap around leads
- Small size
- One hand operation
- Continuity • Diode



QM-1520 $34.95

30 Range
- Large Display
- Transistor Test
- 20 Amp
- Diode Test



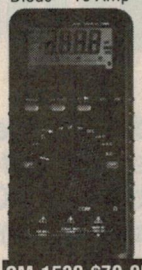
QM-1300 $49.95

Temperature
- Frequency Transistor
- Diode, Continuity
- Capacitance
- Auto Power Off
- Large Display • 20A



QM-1320 $69.95

Auto Range
- 3.5 Digit
- 1999 Count
- Data Hold
- Bargraph
- Diode • 10 Amp



QM-1530 $79.95

4.5 Digit
- Freq Counter •20 Amp
- Transistor/DiodeTest
- Capacitance •Data Hold •Large Display
- Auto Power Off
- 19999 Count



QM-1330 $99.95

TURN YOUR SURPLUS STOCK INTO CASH!!! JAYCAR WILL PURCHASE YOUR SURPLUS STOCKS OF COMPONENTS AND EQUIPMENT. WE ARE CONTINUALLY ON THE LOOKOUT FOR SOURCES OF PRIME QUALITY MERCHANDISE. CALL MARK HARRIS OR BRUCE ROUTLEY NOW ON
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Jaycar ELECTRONICS

Low Cost Train Controller Kit

REF: EA November 1995

NEW

This simple low cost model train controller uses a very effecient phase control system to regulate the speed of your model train, giving good load-speed regulation. Hold the GO button and the train realistically picks up speed as it moves around the track, release the button and it slowly grinds to a halt. Maximum speed is controlled by the throttle, it has forward and reverse, and "emergency stop" just in case. All specified parts, PCB and case supplied. Requires 6-18VAC @ 1 amp depending on train (use MP-3026 $21.50).



Cat. KA-1780 **$29.95**

CD ROM

NEW



Dual speed Japanes made CD ROM. 12 month warranty. Suitable for use with any IBM compatible machine. Supplied with CD ROM drive disk, leads and instructions. Cat XC-4625

Normally $199 NOW $145 Save $54

BEAT THAT

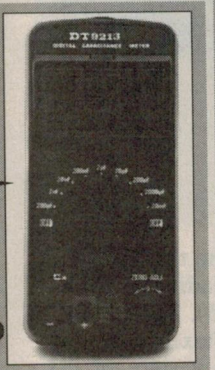
Jaytech Digital Capacitance Meter

BRAND NEW MODEL!!! Has a unique tilting LCD display which allows you to read at any angle. General specs:

NEW

- Display - 3.5 digit LCD
- Range - 9 ranges 200pf to 20mf
- Sampling time - 0.5 seconds
- Accuracy - 0.5% ranges 200pf to 200mf ranges, 1.0% range 2,000uf, 2.0% range 20mf.

Cat. QM-1572 **$99.50**

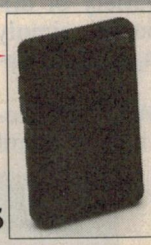


20 SECOND RECORDER

NEW

Record messages up to 20 seconds long. Ideal for remembering telephone numbers you see whilst driving, or reminding yourself to phone someone etc. 20 second recorders previously sold for $29.95. We've sliced $5 off the price. Uses 3 x AAA batteries (not supplied).

Cat. XC-0276 **$24.95**



GOLD CAR HI FI ACCESSORIES

POWER DISTRIBUTION BLOCK
Accepts one 4GA wire to four 8GA out.
Cat. HC-4020 **$14.95**



GOLD BATTERY TERMINALS
With 6mm bolt, & wing nut on which our gold terminals can be connected to run cabling to equipment.
Cat. HC4040 **$12.95**



4 WIRE BATTERY TERMINALS
Accept two 8GA cables and two 4GA cables.
POSITIVE Cat. HC-4042 **$24.95**
NEGATIVE Cat. HC-4043 **$24.95**
SILICON COVER Cat. HC- 4045 **$6.95**



TWO WAY FUSED POWER DISTRIBUTION BLOCK
Accepts one 4GA cable to 2 outputs for 8GA cable.
Cat. SZ-2070 **$29.95**



FOUR WAY FUSED POWER DISTRIBUTION BLOCK
Accepts three 4GA cables, to four 8GA outputs.
Cat. SZ-2072 **$39.95**



GOLD FUSEHOLDER WITH MOUNTING BRACKET
Length 80mm - accepts 5AG fuses.
Cat. SZ-2060 **$12.95**



GOLD INLINE FUSEHOLDERS
Total length is 112mm. Accepts 5AG fuses.
8GA FUSEHOLDER - Cat. SZ-2066 **$9.95**
4GA FUSEHOLDER - Cat. SZ-2068 **$9.95**



Jaycar ELECTRONICS

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FAX: (02) 743 2066	FAX: (02) 743 3070	IN AUST (up to 20kg) $14.00	HOTLINE (02) 743 6144

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$10 - $24.99	$ 4.00
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$50 - $99.99	$ 7.00
OVER $100	$ 8.00

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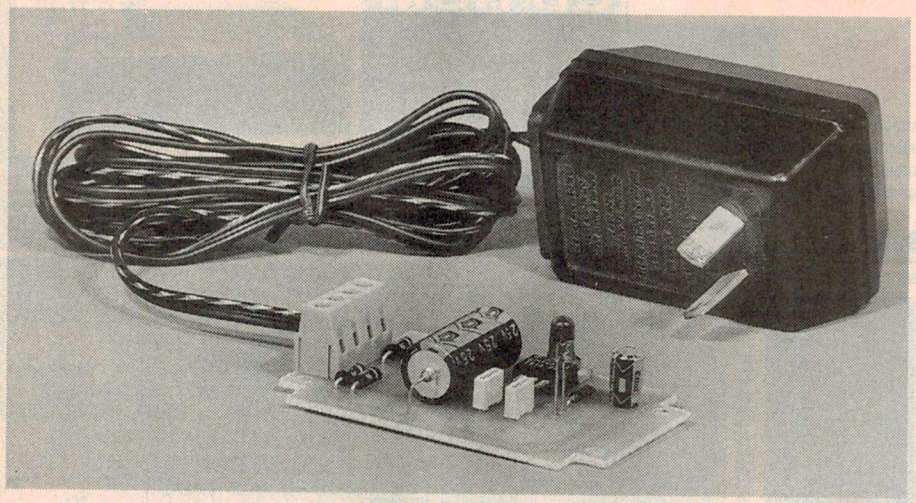
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Mini Construction Project:

FLEXIBLE POWER SUPPLY MODULE

How many times have you designed a small electronic project, only to realise that you needed a dedicated power supply that was *just different enough* from those available off the shelf, that you couldn't use one? Here's a very flexible little PCB module that can be adapted for a wide variety of low power, regulated or unregulated supply configurations.

by JAMES BARKER



Just about every mains-powered electronics project needs a power supply, and although these all tend to have the same basic components (transformer, rectifier and filter, and possibly a regulator), it's surprising how often you need one that's just a bit different from those readily available. Sometimes this is because you want to use a standard transformer, but still end up with an unusual DC supply voltage; other times you might want to have the DC output accurately adjustable. Or perhaps you might want to make use of an odd-ball transformer that's 'on hand'.

There have been a few designs for 'universal' power supply modules to solve this problem, but none of those I've come across seem to have met my own needs. So I sat down and designed my own, and it seems to be quite successful. Hopefully you might find it of value too...

The details

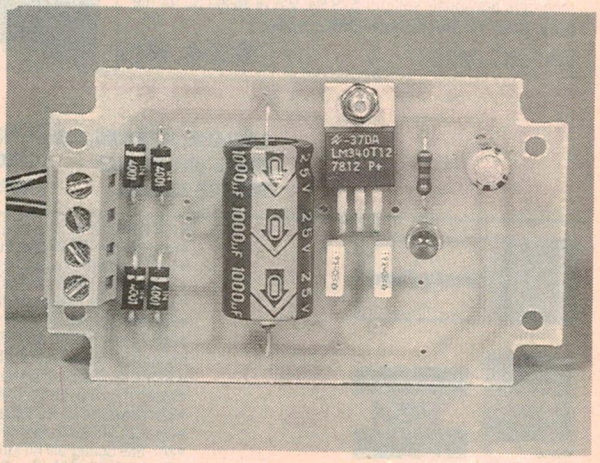
The module is based on a small PC board, measuring 75 x 45mm and with a 'notch' in each corner so that it will fit inside the smallest readily available plastic 'jiffy box' (UB5). The board is designed to be very flexible, so you can configure it for a variety of different types of power supply simply by fitting in (or not fitting in!) the appropriate parts.

For example, you can wire up the rectifier part of the board in a standard bridge configuration with four 1N4001 or similar diodes (as shown), for use with a transformer or AC plug-pack with a single untapped secondary winding. But just as easily, you can fit only two diodes and connect it to a transformer with a centre-tapped winding, as a conventional 'full wave' rectifier, or even fit a single diode and use it with an untapped winding for a simple half-wave rectifier — whatever you need.

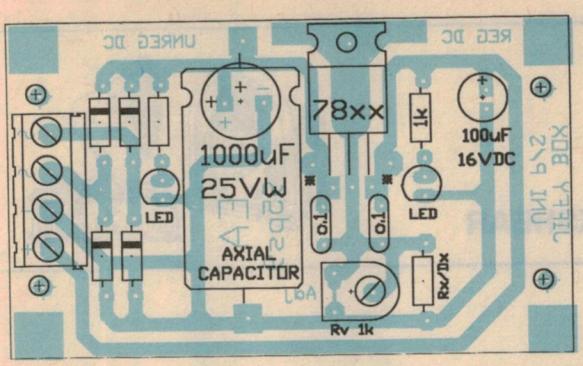
For the main reservoir capacitor, the board will take up to at least a 1000uF/25VW axial lead electro, and probably the same value in a vertical 'RB' type. You could probably squeeze in a 2200uF/16VW electro too, if you get one that's reasonably compact.

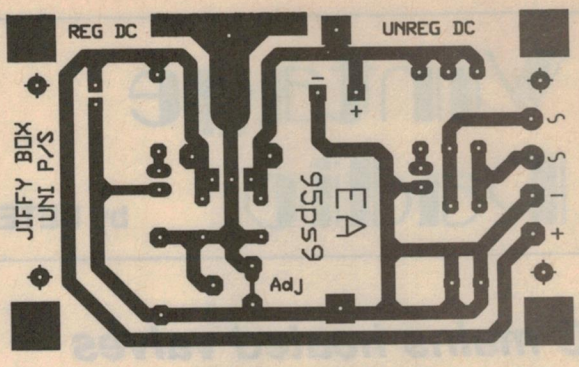
When it comes to regulation, the board has room for any standard three-terminal positive regulator, of either the TO-220 or smaller varieties. To ensure regulator stability, it provides for small bypass caps at both input and output of the chip; you can fit in either 0.1uF ceramics or 2.2uF TAG tantalums, as desired.

For those situations where you need



A close up of the module PCB wired up to produce a 12 volt regulated supply, using a bridge rectifier and with an indicator LED on the output side.





At left is the PCB overlay diagram, to guide you in placing the components when wiring everything up for the configuration of your choice. At right is the etching pattern for the PCB, actual size as usual to allow convenient etching.

an output voltage other than those provided by standard 5/8/12/15V regulator chips, the board also makes it possible to cut the copper track between the regulator's common pin and the negative line, to insert a diode, a zener, a fixed resistor or a preset pot, for 'jacking up' the regulator voltage. If you want to use a pot, it's easy enough to fit a fixed resistor from the positive output rail, to form the usual divider.

There's provision for an output filtering capacitor, in the position marked '100uF/16VW' on the overlay. And for those who like the reassurance of a glowing LED, the board gives you a choice of either one operating from the unregulated rectifier output or one from the regulated output, in each case with a series resistor.

(If you need a 'jacked up' regulator, the top divider resistor fits in place of the output LED and resistor, so you'd have to run the LED from the unregulated rail.)

If you don't need a regulated output, the regulator chip is easily left out and replaced by a wire link or series resistor, connected between the two pads indicated with asterisks on the PCB overlay. In this case you won't need the small caps, preset pot or fixed resistor Rx either; but you might still want to fit an electro in the '100uF' position, to get additional filtering. You can probably squeeze in a 220uF type here, if you need it.

The AC input connections to the module and its DC output connections are all brought out to one end of the PCB, and given large pads spaced to take a small four way PCB-mount terminal block as shown. However if you're building the module into a piece of equipment with permanent connections, you can easily fit four PCB terminal pins instead, or simply solder the wires directly to the pads.

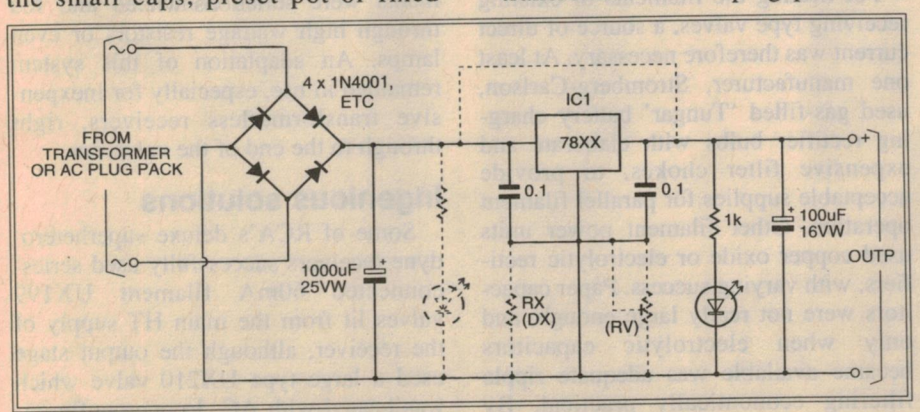
Four mounting holes are provided on the PCB, two at each end just inside the notches. This will allow you to mount the board into a UB5 jiffy box, or even mount it into a larger case via the usual standoffs or spacers.

Pick a voltage...

Needless to say, the voltage level of the module can be whatever you need. The main things to bear in mind are these:

- The voltage rating of your input reservoir cap should be at least 1.5 times the RMS AC voltage input from your transformer or AC plug pack, and preferably twice the AC voltage if you're using a poorly regulated transformer and your supply will sometimes be unloaded. If you use a TAG tantalum cap on the input pin of the regulator, it will need the same voltage rating.
- Similarly the voltage rating of the output cap, if used, will need to be greater than the regulated output voltage (say 16VW for a 12V supply), or equal to that of the input cap if you're not using a regulator.
- If you're using a three-terminal regulator, make sure that the unregulated DC voltage is at least 2.7V higher than your regulated output voltage, to ensure that the regulator has sufficient 'headroom'. If you are running the supply at a fairly high current, make sure that the 2.7V margin still applies at the 'valleys' of the ripple on the unregulated DC — otherwise you'll get ripple in the output.
- If you fit a LED, the series resistor value should be chosen to give a LED current of 3-10mA depending on the brightness you need. To work out the resistor value, allow 2V for the LED voltage drop. For example the 1k series resistor shown will give 3mA for a regulated 5V output ((5V - 2V)/1k), or 10mA for a regulated 12V output ((12V - 2V)/1k).
- If you use a regulator and run it a fairly high current, you may need to fit it with a small heatsink to prevent the regulator overheating and turning itself off. The power dissipation is found by multiplying its voltage drop and the output current.

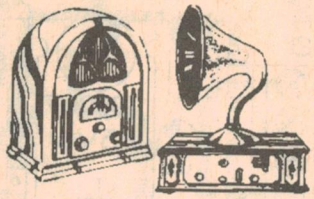
That's about it. It's not an exciting project, but I hope you'll find this module as useful as I have. By the way, thanks to the cooperation of Bob Barnes, who runs RCS Radio, PC boards for the project are now available from that company. You'll find RCS at 651 Forest Road, Bexley NSW 2207; phone (02) 587 3491. ❖



As you can see from the schematic, the module is designed to be quite flexible. The regulator chip can be omitted if you wish, or used to produce non-standard voltages by fitting a diode, fixed resistor or pot in the common lead.

Vintage Radio

by PETER LANKSHEAR



AC mains heated valves

Unlike semiconductors, receiving valves are extremely inefficient — with quite large current and voltage requirements. In the early days of radio, these were usually supplied either by standard dry Leclanche primary batteries, or rechargeable lead-acid secondary types. Primary batteries were convenient, but not normally rechargeable and were relatively expensive. The first cost of rechargeable secondary batteries was even greater, and they were also messy and inconvenient.

Before the days of broadcasting, when the only radio 'traffic' was commercial or amateur communications, the cost of battery supplies was accepted. But when, in the 1920s, domestic entertainment radio 'broadcasting' became popular, there was a growing demand for cheaper and more convenient power sources.

For locations with AC power, reasonably successful high tension supplies or 'B' battery eliminators were developed, incorporating a transformer, rectifier and filtering system. But filament supplies presented serious problems. Using a transformer of the correct voltage was an obvious and simple enough method, and when balanced to earth with a centre tap, AC was satisfactory for high powered audio and transmitting valves. However it was unsuitable for receiving valves.

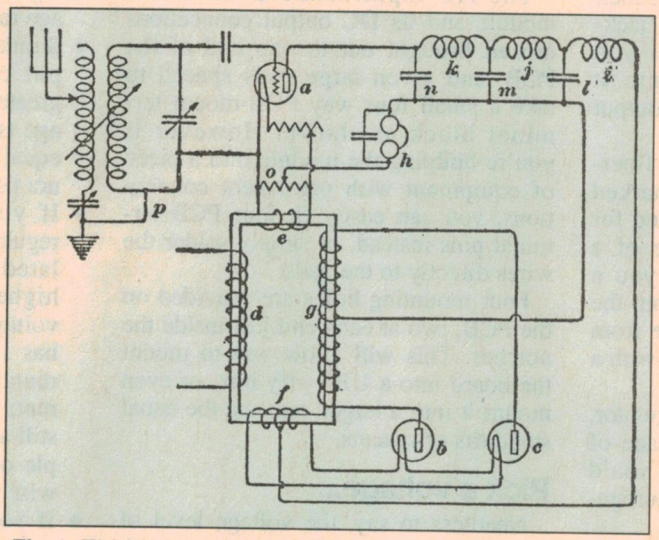


Fig.1: This circuit, found in a 1923 book, illustrates early attempts at all AC operation. It would not have been very successful.

One suggestion dating from the early 1920s is shown in Fig.1. On paper, it looks viable enough, and the HT supply should be satisfactory, but I suspect the circuit was never actually tried before publication! Although the filament supply is balanced to earth, the hum level would still have been quite intolerable.

Receiving valve filaments, even the husky 250mA types, had very little thermal inertia, and cooled sufficiently between each half cycle to modulate the electron stream. Also the alternating electrostatic and magnetic fields around the filaments were impossible to balance out completely.

For heating the filaments of existing receiving type valves, a source of direct current was therefore necessary. At least one manufacturer, Stromberg-Carlson, used gas-filled 'Tungar' battery charging rectifier bulbs with elaborate and expensive filter chokes, to provide acceptable supplies for parallel filament operation. Other filament power units used copper oxide or electrolytic rectifiers, with varying success. Paper capacitors were not really large enough, and only when electrolytic capacitors became available was adequate ripple filtering economically practical. By then, valves designed for AC operation were coming available anyway.

Mains powering was a more practical proposition if the filaments were series connected. The first recorded attempt was as early as June 1924, when the American 'Dynergy' receiver appeared using the standard 250mA filament 201A valves — lit by rectified and filtered current supplied by a pair of Tungar bulbs. But there is no record of this receiver ever being in production.

Later, a few American manufacturers used the Raytheon cold cathode type BA gas filled rectifier, which could deliver up to 350mA to provide both high tension and filament currents.

In areas with DC power mains, it was possible to filter commutator ripple more or less adequately to supply all power to specially designed receivers. Valve filaments were series connected and fed through high wattage resistors or even lamps. An adaptation of this system remained in use, especially for inexpensive transformerless receivers, right through to the end of the valve era.

Ingenious solutions

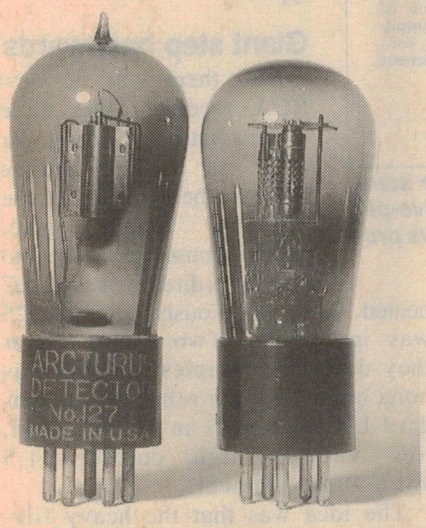
Some of RCA's deluxe superheterodyne receivers successfully used series-connected 60mA filament UX199 valves lit from the main HT supply of the receiver, although the output stage used a large type UX210 valve which was heated with AC. In one configuration, this receiver was paired with the RCA Rice-Kellogg Type 104 Speaker system described in this column back in

May 1990. The husky power supply had no trouble in providing the extra filament current.

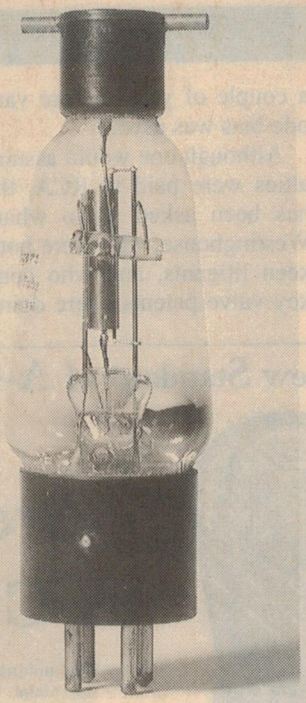
Although this form of filament supply was superseded within a couple of years, many readers will be aware that it was resurrected very successfully about 25 years later with the availability of the 1.4 volt 50mA filament seven-pin miniature dry battery powered valves, in what became known as AC/Battery portables which had the option of operating either from the mains where available, or from dry batteries.

A most ingenious solution was used by the Fansteel Company in their 1928 Balkeit B7 and B9 receivers. They used a small 4MHz transmitter to generate the 6.25 watts required to light five 01A valves. There would have been some problems, of course. To avoid intolerable interference, the oscillator frequency had to be well above the range covered by the receiver. As not many servicemen would have had RF voltmeters, it would have been difficult to adjust the exact filament voltage, and with the available technology, the only way to control receiver gain was by means of a volume control at the aerial input. For all that, it was a practical system, and may well have been used more if the indirectly heated valve had not been developed.

These 'work around' methods were all expensive and were restricted to prestige receivers. Many listeners, obliged to use standard battery receivers, compromised by using a mains powered 'B' eliminator for HT and a lead-acid battery for the filament supply. Trickle chargers could be used to keep the batteries charged, but only between periods of radio use, for they generated too much noise and interference for float charging.



A pair of early blue Arcturus type 127 valves. As the base engraving on the left hand example makes it clear, at first these valves were restricted to detector applications.



The first indirectly heated valve was the McCullough 401, available in 1925. Soon afterwards very similar valves appeared with the Kellogg label, and then as the Canadian Rogers type 32 shown here.

Solution already existed

The methods that have been described were makeshift compromises. Valves were needed that could be lit with an AC filament supply, and it is ironical that the solution had already been around for the best part of 10 years!

Back in 1914, in efforts to tame what was originally a crude and temperamental curiosity, much research and development was going on in Europe, Britain and America into valve design and behaviour. One problem encountered was the potential drop along the length of the filament. This variation meant that only one small section of the filament operated at exactly the correct bias. In practical operation this could be allowed for by basing calculations on the mid-point voltage, but for researching the exact valve characteristics, it was an annoying complication. What was required was a *uni-potential* cathode.

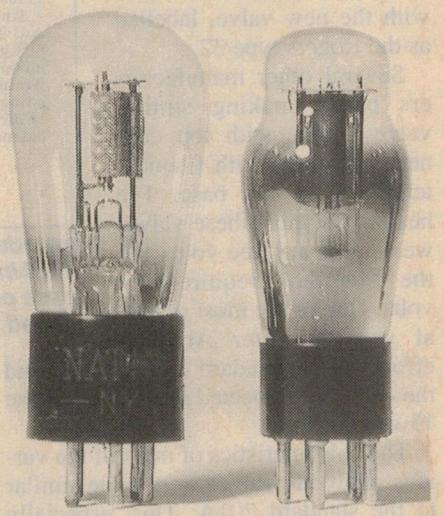
In Britain, Marconi's H.G. Round hit upon the idea of using a platinum sleeve coated with calcium oxide. This sleeve was heated by, but spaced from, a central carbon hairpin filament operating with DC. Why carbon was chosen has not been explained, but I suspect that it was to minimise any emission from the heater itself, a possibility if tungsten had been used. Round's patent was taken out in May 1914.

Meanwhile in America, A.M. Nicholson of Western Electric, having encountered a similar problem, also developed and applied for the patent in 1915 for a uni-potential cathode, again an internally heated sleeve.

There was no reference to AC heating of either of these indirectly heated cathodes, and presumably with their research work completed, Marconi and Western Electric filed their patents away. Valves continued to be fitted with directly heated filaments.

Next we come to late 1922. Hubert Freeman and Wallace Wade of Westinghouse (a part owner of RCA) applied for patents for several indirectly heated cathodes, one using a doubled-over filament with the two halves closely spaced and insulated by an inert mineral sleeve. This assembly was inserted into a metal cylinder coated with strontium and barium oxides — a construction which became the pattern for early production of indirectly heated valves.

Another Westinghouse employee at the time was F.S. McCullough, who a couple of years later set up in business



Many manufacturers followed RCA's lead and, as can be seen in National Union 27 at the left, minimised heating by using mesh anodes. The smaller stepped dome envelope on the RCA 27 at the right was introduced in 1932.

as the McCullough Sales Company of Pittsburgh. During mid 1925 he was advertising AC heated valves, which soon after were being made by the Kellogg Supply and Switchboard Co.

First AC valves

These McCullough/Kellogg type 401 valves were the first American genuine AC type, and had a most distinctive shape and construction. The standard receiving valve envelope at the time was known as the 'S' bulb, with a spherical top tapering down to the base. However the Kellogg envelope was inverted, being widest immediately above the base, and tapering to a significantly narrower top. A large Bakelite top cap had two projecting 'horns' for connecting to the heater wiring. The cathode was connected to what would have normally been one of the filament pins.

Working closely with McCullough was the Canadian pioneer Edward S. Rogers, who set up in business in Toronto and later in 1925 sold his Rogers Batteryless receivers fitted with the new valve, labelled as the Rogers type 32.

Several other manufacturers began making similar valves, some with top connectors, others with filament terminals on the base. The heaters for most these valves were rated at three volts, but the Marathon required six volts. One of the most unusual was the later Arcturus effort, with a standard four-pin base and the cathode connected to one end of the 15 volt filament.

The characteristics of most of the various indirectly valves were quite similar to the standard 201A. This, especially with the top heater wiring, enabled a simple conversion of existing receivers to mains operation — although there were practical problems as most sets used filament temperature for volume control, and thermal delay ruled this out for indirectly heated valves. It was to be a couple of years before variable cathode bias was used.

Although one would assume that royalties were paid to RCA, the question has been asked as to what they and Westinghouse, who were both normally keen litigants, and who controlled the key valve patents, were doing allowing this relative 'free for all' to go on — the more so when one of their ex-employees McCullough, was marketing a product of Westinghouse research. After all, if it worked, here was a development that could and eventually did have tremendous market potential.

One theory is that there were doubts about the eventual success of the indirectly heated cathode, which still had some serious shortcomings, and it was convenient to let independent small companies find out the problems. But as we shall see, there may have been another factor.

RCA at the time had a big stock of unsold receivers, including the mains-powered model 30 superhet mentioned previously. It was better perhaps to sit back and pick up the AC valve later when the dust had settled, and present receiver stocks were quit...

Westinghouse meanwhile continued with their development of AC valves, and in July 1925 sent some samples of a double-ended valve to RCA. The filament connector on the top appears in photographs to have been a small bayonet lamp fitting. Nothing further is reported to have happened until April 1926, when further samples were delivered to RCA, presumably for more testing. In June 1926, the new valve was given the designation of UX225.

At this stage, readers are reminded of the early American valve numbering 'system'. Only the last two digits and any suffix letters were significant. Thus UX201A, 201A, 301A and 01A all applied to the one valve. Similarly, UY227, 127, 227, 327, and 427 were all type 27.

Giant step backwards

Still there was no new RCA receiver. But three months later, in September 1926, in another strange move in the evolution of the indirectly heated valve, Westinghouse was asked to develop a directly heated AC heated valve. Obviously, the UX225 was in trouble. Two months later they delivered samples of what was none other than the reliable old standard UX201A with an oxide coated, low voltage high current (1.5 volt/1.05A) filament!

The idea was that the heavy filament would minimise thermal variations, while the small voltage would reduce electrostatic hum generation. This AC version of the 01A was in fact satisfactory for amplifier service,

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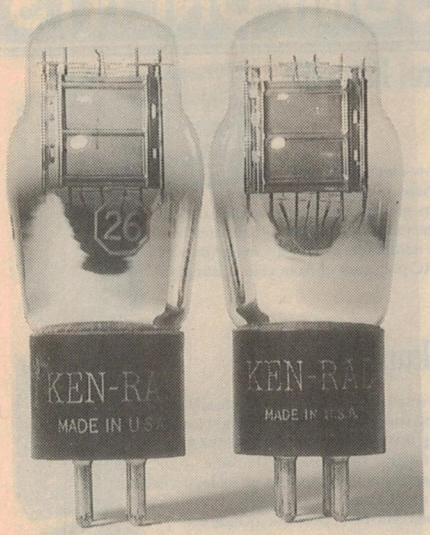
The freedom from hum which is one of the most important features of Arcturus A-C Tubes, is due to the use of low A-C current, only 0.35 ampere. Arcturus Tubes in all stages are four element tubes with indirectly heated cathodes.

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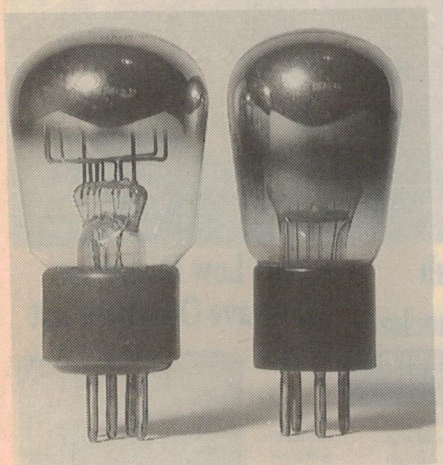
Introduced late in 1927, the 27 rapidly became the standard indirectly heated amplifier valve; but the new five-pin base prevented its use in existing receivers. Arcturus produced this four pin version to help out.



This photo of a pair of replacement valves shows clearly the similarity between the parent 01A (right) and the 26. The only visible difference is the number of filament tensioners, the 26 having a simple inverted V filament while the longer filament of the 01A has an M configuration.

but it was a backward step technically, and the residual hum made it unsuitable for a detector.

There was a further a delay of more than six months until in April 1927, the indirectly heated valve was finally given the OK by RCA for detector service — although now it was single ended, with a new five-pin base and called the UY227. It become the first 'mainline' cathode type American valve, and was officially released in May 1927.



British indirectly heated valves were in production in 1927 and equivalent European valves were available the following year. At the left the valve with horizontal elements is Philips E416\5. The other is Telefunken's first mains heated valve, the REN1104.

Meanwhile, Britain and Europe were right up with the play. In January 1927, Marconi-Osram had introduced the KL1 indirectly heated triode, originally intended to have a carbon filament. Germany too was not far behind, and in 1928 Telefunken produced the REN1104.

Finally, in September 1927, the AC heated version of the 201A was announced, named the 226. At the same time, the RCA model 17 TRF receiver was released for sale. This was RCA's first receiver to use AC valves, with four of the 226 valves as amplifiers, and a 227 detector. The model 17 is generally regarded as the first receiver to use the 'mainline' series of mains heated valves.

Delays, malfunctions

It was more than two years after McCullough commenced production, and Westinghouse had made some samples of indirectly heated valves, that RCA marketed an AC valved receiver. Just why there was such a long delay has never been explained, but Alan Douglas provides a clue in volume III of *Radio Manufacturers of the 1920's*.

RCA suffered from being a large inflexible organisation, whose research and marketing sections did not always see eye to eye. Mistakes, delays and overproduction occurred that would have put a smaller organisation out of business. So enormous was the receiver inventory held over from 1925-26, that RCA skipped the 1926-27 season altogether.

There were problems with the 227. When it was eventually released, it was restricted to detector service. It appears that there were heat dissipation problems, which limited it to low anode voltage and current operation.

It will be noted that the original indirectly heated valves had small bright cylindrical anodes, much smaller in area than that of the 201A and closely surrounding the cathode — which in the case of the 227, radiated more than four watts. It is quite possible that in amplifier service, with an additional extra watt or so of anode dissipation, the grid (sandwiched between two hot electrodes) could itself have become hot enough to emit electrons.

Significantly, receivers with Kellogg valves had HT supplies limited to about 100 volts. As can be seen in the photo of the Arcturus type 127 valves, the original 'detector' version had a solid anode, but that of the later, general purpose type was perforated. For the same reason RCA 227's were fitted with gauze anodes, until in the 1930's they were given blackened solid types for improved heat radiation.

Another problem reported was unreliability of heaters, with the early examples being prone to fracture. Consequently, the common sense thing to do until the bugs were eliminated, was to restrict use of the 27 to detector service, where there was no practical alternative and where conditions were not so torrid, and use a more reliable design and lower filament wattage in the form of the 26 for use in amplifier stages. This pattern was adopted by many manufacturers keen to get into mains powered receiver production.

By 1929, the problems of the 27 were sorted out, and it became widely used as a very successful general purpose triode. Most of the independent styles soon disappeared. By the way, a consequence of the use of the type 26 for only the 1927/28 season is that dating of these receivers is particularly easy.

We have been able to provide only an outline of this intriguing story, and for readers who wish to learn more the following books are recommended:

70 Years of Radio Tubes and Valves, by John W. Stokes (Vestal Press)

History of the British Radio Valve, by Keith R. Thrower (MMA International)

Saga of the Vacuum Tube, by Gerald F.J. Tyne (H.W. Sams)

75 Years of Western Electric Tube Manufacturing by Bernard Magers (Antique Electronic Supply Co.) ❖

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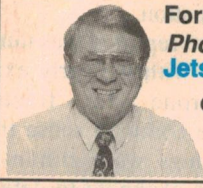
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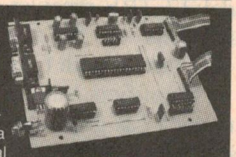
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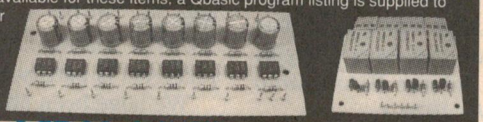
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K 2850 **$69**

Input Buffer & Relay Driver Kit

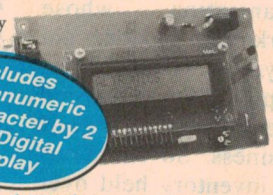
Combined, the K 2850 & the K 2852 Allow You to Switch Appliances On and Off with Your Computer!

(See EA Feb '89) This is a companion kit for our I/O Adaptor kit (K 2850). It has four relay outputs and eight opto-isolated inputs. This kit contains all parts necessary to construct both the input and output stages and even gives basic information on 240 volt triac controlling. As there is no professional software available for these items, a Qbasic program listing is supplied to help you complete your project.



K 2852
$34.95

Alphanumeric LCD Module Kit

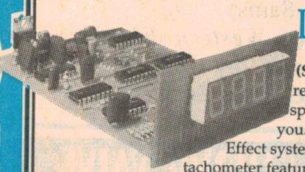


(See SC May '93) Using an alphanumeric LCD display board is not as hard as you may have thought. This kit is certainly the easiest way of learning about these devices. Simply connects straight to your printer port of your PC. N.B. requires software.

Includes Alphanumeric 16 Character by 2 Line Digital Display

K 2825 **$39.95**
K 2827 3.5" PC Software Disk **$14.00**

LED Digital Tachometer Kit

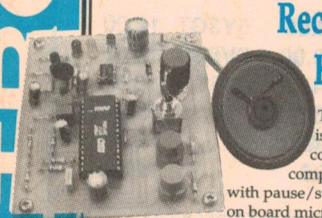


(See SC Aug '91) Have you ever wondered how many revs your car's engine is doing at 100km/h or at any speed for that matter? This digital tachometer will tell you. It works with all ignitions from Kettering to Hall Effect systems and with 4, 6 and 8 cylinder cars. This new tachometer features a bright 4-digit readout that indicates 0-9900 RPM with a resolution of 100 RPM. This unit will work with just about any ignition system. Only three connections are required to connect the unit to your car: one to the negative terminal of the coil and two for power (+12V and GND).

Suits all 4, 6, 8 Cylinder Cars. Works on Kettering & Hall Effect Ignition Systems

K 4320 **$32**

90 Second Message Recorder Kit

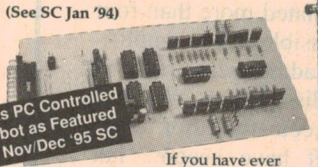


This module is fully self contained, complete with pause/start key, on board microphone for direct recording, in built audio amplifier and playback button. The sound quality is quite suitable for static displays, alarms systems, monitoring systems. Public address systems etc. Powered from an external 6V DC supply. Even if power is removed the message will not be lost.

K 9570 Was $95, Now **$75**

Parallel Port Stepper Motor Controller Kit

(See SC Jan '94)



Suits PC Controlled Robot as Featured in Nov/Dec '95 SC

If you have ever wanted to experiment with stepper motors then this kit is ideal. It plugs directly into any standard printer port and can control two stepper motors as standard, but can be cascaded to control up to eight stepper motors. Requires external 12 Volt power supply.

K 2830 **$49.95**
K 2832 Software to Suit 3.5" Disk **$14.95**

Model Train Control Kit with Simulated Inertia

As Featured in This Month's Electronics Australia



(See EA Nov '95) This simple, low-cost model train controller uses a very efficient phase control system to regulate the speed of your model train, giving better load-speed regulation. It also simulates inertia and momentum, making the train run much more realistically. A worthwhile addition to almost any model railway layout. Operates from a 6-18 V AC plug pack or from your existing AC train supply.

K 8010 **$29.95**

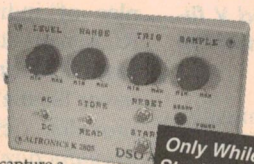
Induction Loop Pickup Kit



(See EA Oct '95) Here is a novel way to listen to the television, CD etc with headphones but without long wires back to the set. Handy for listening to TV in bed, or for getting 'that little bit more volume' without irritating other members of your family. This works on the same principal of induction loops for hearing aids. Simply set up by laying cable around the ceiling or floor of the room. Full details supplied. Receiver can fit in pocket or clipped onto belt. Does not include earphones.

K 5200 **$24.95**

Digital Storage C.R.O. Adaptor for P.C.'s Kit

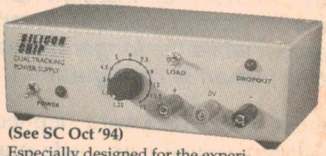


(See EA Jan '93) This great kit enables a P.C. user to capture a waveform and zoom in to segments of interest then save them to disc. The unit has 32K of storage memory and a sampling rate of over 600K samples per second. Input level of up to 2.5 Volt. Full sampling rate between 15K s/s to over 600K s/s. Input impedance of 1M ohm.

Only While Stocks Last

K 2805 Normally $63.50,
This Month Only $55
K 2812 PC 3.5" Disk Software to Suit **$29.95**

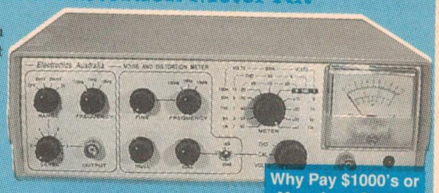
Economy Dual Rail Power Supply Kit



(See SC Oct '94)
Especially designed for the experimenter. No mains wiring required as the supply uses a 16V AC 1 amp plugpack. Outputs include 11 switch selectable dual rail voltages - 1.25V, 1.5V, 3V, 4.5V, 5V, 6V, 7.5V, 9V, 12V, 13.5V and 15V. Features on/off load switch, and drop out indicator. Up to 500mA of current available. Supplied complete with screen printed case.

K 3240 Normally $39.95
This Month Only $29
M 9125 16V AC Plugpack to Suit **$17.95**

Low Cost Noise and Distortion Meter Kit

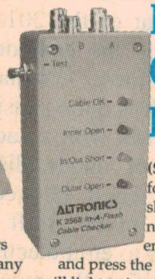


(See EA May/June '93) If you design, service, or experiment with audio equipment, this new instrument will fill a gap in your range of test gear. It can measure distortion levels down to less than 0.01% at spot frequencies of 100Hz, 1KHz and 10KHz, as well as providing a built-in low distortion oscillator and AC millivoltmeter. Best of all, it costs a fraction of commercial equivalents!

Why Pay $1000's or More for a Similar Commercial Unit Build Your Own & Save a Fortune

K 2542 Normally $129 **This Month Only $99**

In-A-Flash Cable Checker Kit



Check Coaxial and Shielded Cables in an Instant!

(See EA Nov '94) Fantastic for checking coaxial and shielded cables. All you need to do is connect both ends of the cable to the tester and press the button. One of four LEDs will light to instantly indicate cable status. Indicators include okay, inner wire open, outer shield open or inner - outer short. Includes BNC and RCA input sockets. A brilliant addition to your electronic tool kit! Supplied compete with silk screened case.

K 2568 **$18.95**

3 Spot Low Distortion Sinewave Oscillator Kit



(See SC December '94)
This fantastic sinewave oscillator features super low distortion and high output. It has three selectable frequencies and an output level control. Ideal for building and testing audio and speaker projects. 3 switch selectable frequencies at 100Hz, 1kHz and 10kHz. 2V RMS output, less than 0.004% distortion, Variable level output.

K 2545 Was $59.95, Now **$45**
M 9125 16V AC Plugpack to Suit **$17.95**

1-800 999 007 **PERTH (09) 328 1599**

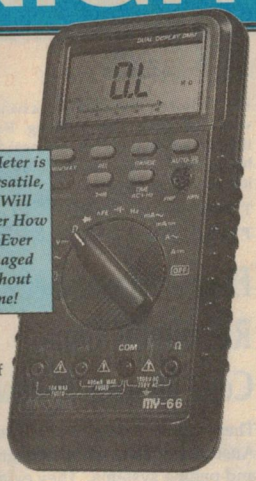
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OVERNIGHT DELIVERY

ALTRONICS

Fax Order Line: (09) 328 3487

3.75 Digit Dual Display Auto Ranging Digital Multimeter



This Meter is So Versatile, You Will Wonder How You Ever Managed Without One!

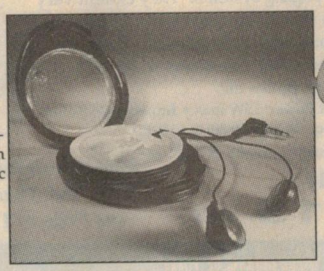
One of the Best and Most Popular Meters We've Ever Stocked!

This fantastic auto-ranging meter features minimum and maximum functions. Memorise an input for later reference. Continuity and diode check. Can measure AC voltage and frequency simultaneously. Capacitance test 4nF to 40µF. Frequency check 10Hz to 120kHz. Transistor gain check for both NPN and PNP transistors. 41 segment analogue bargraph, stopwatch function, 10 amp fuse protection and full 2 year warranty. Relative sampling displays either % or actual value difference of the current input compared to a memorised input. Auto power off. Large 16mm 3.75 digit display with bargraph.

Please call us or a full specification sheet.

Q 1045 **$179**

Inner Ear Phones



In our opinion, these very rugged, brilliant reproduction earphones compare very favourably with the Sony yet at a fraction of the price. The set comes complete with gold plated right angle 3.5mm plug and "wind up" carry case. Fantastic for personal stereos, video cameras etc.

C 9005 Normally $19.95,

This Month Only **$10**

Solar & Battery Powered AM/FM Radio



Fantastic for sports fans and lovers of the great outdoors! No need to worry about batteries next time you go to the cricket or out gardening etc. Inbuilt solar cells will charge the internal nicad battery. Will automatically use a standard (non-rechargeable) AA battery should the nicad run out (ie. night time use). Supplied complete with earphones!

A 2250 Normally $39.95, This Month Only **$25**

Solar, Dynamo & Battery Powered AM/FM Radio



Features: Built in solar panel and dynamo generator, can be fitted with 2 "AA" batteries (for backup at night) and provision for DC external plugpack. Built in nicad backup battery is charged by the radio's own solar panel.

A 2255 Normally $49.95, This Month Only **$30**

UHF Processor-Controlled Home Security System



Why Pay A Commercial Security Firm A Fortune To Wire Your House or Office?

Apart from the flawless operation of the system, one of the great features is its application with rented or leased premises.

Let's face it, money spent on installing a wired system in your home or office, factory, etc is irrevocably lost when you move on. With this system you simply take it with you.

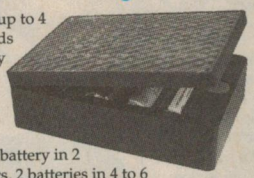
System Includes:

• 1 x Control Panel • 1 x Passive Infra Red Detector/Transmitter • 1 x Door-Window reed Switch/Transmitter • 1 x Hand Held Remote Control/Transmitter • 1 x External Siren and Enclosure (wired) • 1 x 240V AC adaptor • 1 x 10m wiring harness for external siren • Includes cable clips and fixing hardware • 1 x 1.2Ah Backup Battery

S 5262 Complete System **$499**

Charge Your Batteries Free From the Sun!
Ideal for camping, boating, travelling etc. Simply insert the batteries and place in direct sunlight. eg on your car dashboard.

AA Solar Charger



Charges up to 4 AA Nicads by simply placing in the sunlight. Will charge 1 battery in 2 to 3 hours, 2 batteries in 4 to 6 hours, 3 batteries in 7 to 10 hours and 4 batteries in 10 to 14 hours with full sunlight.

A 0230 Normally $16.95,

This Month **$10**

Multi-Purpose Solar Charger



Charges 2 AA, AAA, C or D size batteries at the same time. Will charge in 10 to 14 hours with full sunlight.

A 0240 Normally $29.95,

This Month **$25**

Car Voltage Adaptor

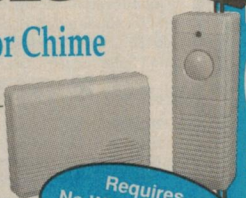


This handy unit simply plugs into your car's cigarette lighter socket and presto! Gives you switchable 3, 4.5, 6, 7.5, 9 and 12V DC at up to 800mA. Includes a range of output plugs. Reversible polarity. Great for pocket TV's etc.

M 8150 Normally $16.95

This Month Only **$10**

Wireless Door Chime



Requires No Wiring - Installs in Minutes!

A nifty wireless doorbell with remote receiver. The attractive slimline transmitter simply mounts onto the front door frame/wall etc, while the receiver can be placed anywhere inside (up to 30m away). The receiver incorporates an inbuilt clip to mount onto the wall etc, can stand on a desk or you can even carry it around with you. Transmitter requires 2 x AAA batteries and the receiver requires 2 x AA batteries.

A 0350 **$35.90**

24 Hour Timer

These Timers Are Made by the Same Manufacturer as Those Sold by Major Hardware Stores & Super Markets!



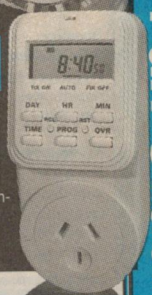
Programming is done by simply inserting the supplied pins into the appropriate time slots. On and off times are in multiples of 30 minutes. Includes manual on/off switch.

A 0301 Normally $26.50, This Month Only **$16.50**

These Timers Can be Used for Security, Pool Pumps & Heaters, Electric Blankets, Lights, Radios, Reticulation etc.

7 Day Electronic Timer

This Month Save 30%



Excellent for home security. 6 different programs can be set to activate any specified day of the week. All 6 programs operate independent of each other. With normal operation the in-built LCD digital display clearly shows the current time and day of the week. Internal rechargeable backup battery will maintain all program settings and current time for up to approximately 100 hours in the event of a power failure. Simple to program. Includes manual on/off/automatic control. 16 amp at 240V AC maximum current rating.

A 0303 Normally $49.50, This Month Only **$34.50**

Mini Personal Alarm

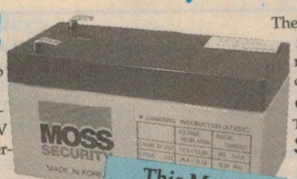
Scare off Would be Thieves or Attackers!



A great little personal security device. This device has a very loud 100dB siren. Small enough to fit in a pocket or handbag or can clip onto a belt. Simply activated by pulling out the pin. Unit is disarmed by re-inserting the pin. A must for those travelling at night.

S 5330 **$12.50**

1.2Ah Lead Acid Battery Bargain!

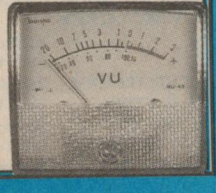


We have scoop purchased a limited quantity of 1.2Ah 12V lead acid batteries, and can offer them at a super bargain price. These units have a variety of applications including alarm system back-up power supplies, UPS's, emergency lights, etc.

This Month Only $19.95 ea or 2 for $35 Save Over 50% Limit 4 per customer

SA5065 Normally valued at $39.95

VU Panel Meters



These quality meters are ideal for amplifier projects or replacement units. MU45 quality class 2.5.

Q 0528 Normally $19.95

This Month Only **$15**

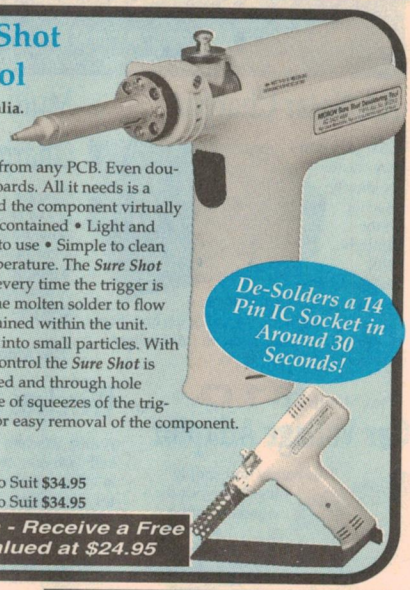
1-800 999 007 PERTH (09) 328 1599

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ALTRONICS COMPONENTS

ALTRONICS Fax Order Line: (09) 328 3487

Micron Sure Shot Desoldering Tool



Exclusive to Altronics in Australia. This stand alone, fully self-contained desoldering tool makes it a breeze to remove components from any PCB. Even double sided, through hole plated boards. All it needs is a squeeze or two on the trigger and the component virtually falls out. **Features:** • Totally self contained • Light and compact • Anti static tip • Easy to use • Simple to clean and maintain • Variable tip temperature. The *Sure Shot* generates a high speed vacuum every time the trigger is squeezed. This vacuum causes the molten solder to flow into the collection reservoir contained within the unit. Here the molten solder solidifies into small particles. With its inbuilt variable temperature control the *Sure Shot* is ideal for single sided, double sided and through hole plated P.C.B.'s. With just a couple of squeezes of the trigger all holes are left solder-free for easy removal of the component.

De-Solders a 14 Pin IC Socket in Around 30 Seconds!

T 1280 **$349**

T 1282 1.0mm Replacement Tip to Suit **$34.95**
T 1283 1.6mm Replacement Tip to Suit **$34.95**

Bonus This Month - Receive a Free Bench Stand Valued at $24.95

PCB Stands

Just Like an Extra Pair of Hands!



Have you ever needed an extra hand when trying to build something. If so then these stands could be your answer. With a heavy and sturdy base this makes the ideal companion for your work bench.

T 1450 PCB Stand **$9.95**
T 1460 PCB Stand with Magnifier **$16.75**

Great for Holding PCB's When Soldering etc

High Performance REDBACK Dual Cone 200mm Speaker

Amazing Offer! Over 50% Off. Strictly Limited - Only 100 Pairs Available at This Price



These speakers are the very same as used by contractors Australia wide in major background music and paging systems. They exhibit very high sensitivity due to the unique magnet and cone arrangement. Excellent for extension speakers for games rooms, patios etc.

Input Power: 15W max • **Impedance:** 8 ohm
• **Freq. Response:** 80Hz - 18kHz
• C 2000 Normally $16.50 ea

Only $15 Pair

This Month Buy 2 for Less Than the Price of 1

C 0805 Slimline White Ceiling Grill to Suit **$4.95** ea

Stereo Headphones with Dynamic Mic

Altronics Retail Store Perth Now Open Extended Hours
Saturday - 8:30am to 5:00pm
Sunday - 12:00pm to 5:00pm



Mylar stereo headsets and dynamic mic combination. Ideal for amateur radios, telephone receptionists etc.
C 9055 Normally $54.95

This Month Only $45

Speaker Specifications:
Frequency Response: ..20Hz-20,000Hz
Impedance: 32 Ohm
Plug Size: 3.5mm stereo jack, with 6.35mm adaptor

Microphone Specifications:
Type: Dynamic
Impedance: 300 Ohm
Frequency Response: 100Hz-15,000Hz
Sensitivity:-80dB @ 1KHz
Plug Size: 3.5mm Mono Jack

CADIK Micro Jet Gas Blow Torch



Powered by a common disposable type gas lighter, this unique blow torch burns at 1300°C, making it ideal for all types of braising and heavy duty soldering. With it's ergonomic design, the Micro Jet can be ignited and used simply with one hand. It has an in-built piezo electronic ignition system which ensures easy lighting every time. Ideal for the workshop, tool box, work bench etc. Suitable for Heavy Duty Soldering, Brazing, Silver Soldering, hobbies, Model Construction etc.

As Reviewed by Silicon Chip Magazine May '94

T 2490 **$29.95**

FM Wireless Mic

C 0348 Normally $29.95 **$20**



This wireless microphone will transmit to any standard FM radio receiver (88-108MHz) making it ideal for lecturing, public speaking etc. Length approximately 70mm. Includes tie clip and neck cord. Requires button battery (supplied).

Modular Parts Carry Case



This unique design enables separate cases to be 'clipped' into a carry handle. Each individual case is supplied with adjustable internal dividers allowing you to customise compartments to suit your requirements. 2 size carry handles are available. The single model H 0253 is supplied with 2 small and 1 large parts case. The double model H 0255 is supplied with 4 small and 2 large parts cases. Each parts case is easily removed from the carry handle. All feature an integral hinged lid and with catches. Individual replacement cases available. (Parts not included).

Great for Service Technicians for Storing Fuses, Nuts, Bolts Components etc

H 0253 Single Model Was $10.95 Now Only **$7**

H 0255 Double Model Was $21.95 Now Only **$15**

ALTRONICS
174 Roe St. Perth W.A. 6000
Phone (09) 328 1599, **Fax** (09) 328 3487
MAIL ORDERS C/- P.O. Box 8350
Perth Business Centre, W.A. 6849

We welcome ... bankcard MasterCard VISA

Standard Delivery & Packing Charge: $4.00 to 500gms, $5.50 500gms-1 kg, $8.00 1kg-5kg. Where possible we process your order the day received and despatch via Australia Post. Allow approx 9 days from day you post order to when you receive goods.

Overnight Jetservice: Up to 3kg is $10.00, 3kg to 5kg is $18.00—We will process your order the day received (if placed before 2.00PM WST) and despatched for delivery the next day. Country areas please allow an additional 24-48 hours.

Heavy Service: All orders of 10kgs or more must travel Express Road—Please allow up to 7 days for delivery. $12.00 to 10kgs. $15.00 over 10kgs. **Insurance:** As with virtually every other Australian supplier, we send goods at consignee's risk. Should you require insurance cover against loss or damage please add $1.00 per $100 of order value (minimum charge $1). When phone ordering please request "Insurance". **Altronics Resellers:** Chances are there is an Altronics Reseller right near you—check this list or phone us for details of the nearest dealer. Blue Ribbon Dealers are highlighted with a ●. These dealers generally carry a comprehensive range of Altronic products and kits or will order any required item for you.

WA - COUNTRY

ALBANY	BP Electronics ●	(098) 412681
	Micro Electronics	(098) 412077
BUNBURY	Micro Electronics	(097) 216222
ESPERANCE	Esperance Comm.	(090) 713344
KALGOORLIE	Golden Mile Electronics	(090) 215212
PORT HEDLAND	Ivan Tomek Electronics	(091) 732531
ROCKINGHAM	TV Joe's	(09) 5271806

VIC - CITY

	All Electronic Comp.	(03) 96623506
	TECS ●	(03) 96706474
CHELTENHAM	Talking Electronics	(03) 95842386
CLAYTON	TECS ●	(03) 95629501
CROYDON	Truscott Electronics ●	(03) 97233860
FOOTSCRAY	G.B. Telespares	(03) 93266035
PRESTON	Preston Electronics ●	(03) 94840191

COUNTRY

BALLARAT	Ballarat Electronics	(053) 311947
BENDIGO	Sumner Electronics	(054) 431977
MILDURA	Truscott Electronics ●	(050) 238138
SHEPPARTON	Andrew Guyatt Elect.	(058) 219497

QLD - CITY

	Delsound PL●	(07) 38396155
NEWSTEAD	E.C.Q.	(07) 32541153
WEST END	B.A.S. Audiotronics	(07) 38447566
WOODRIDGE	David Hall Elect.●	(07) 38082777

COUNTRY

GLADSTONE	Gladstone Elect. Services	(079) 724459
MAROOCHYDORE	Mals Electronics ●	(074) 436119
TOWNSVILLE	Super Solex ●	(077) 724466

TAS

HOBART	G.H.E. Electronics ●	(002) 342233
LAUNCESTON	G.H.E. Electronics ●	(003) 316533

NT

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KATHERINE	Logicware	(089) 723030

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	Force Electronics ●	(08) 2125505
BRIGHTON	Force Electronics ●	(08) 3770512
ENFIELD	Aztronics ●	(08) 3496340
FINDON	Force Electronics ●	(08) 3471188
HOLDEN HILL	Force Electronics ●	(08) 2617088
LONSDALE	Force Electronics ●	(08) 3260901
SALISBURY	Force Electronics ●	(08) 2830755

NSW - CITY

	David Reid Elect. ●	(02) 2671385
SMITHFIELD	Chantronics	(02) 6097218

COUNTRY

COFFS HARBOUR	Coffs Habour Elect.	(066) 525684
NEWCASTLE	Novocastrian Elect.Supplies	(049) 621358
WARNERS BAY	Vilec Distributors	(049) 566792
WOLLONGONG	Newtek Electronics ●	(042) 271620
	Vimcom Electronics	(042) 284400

1-800 999 007 **PERTH (09) 328 1599**

50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

November 1945

Artificial crystals: Due to the present difficulty in obtaining natural quartz in Switzerland, the firm of Brown-Boveri, of Baden, are 'growing' artificial piezo-electric crystals. The manufacturing process used was developed by Prof Scherrer, of the Swiss Federal Institute of Technology. It is stated that the artificial crystals differ only slightly in their properties from those of natural quartz.

Peacetime radar: British merchant ships will shortly be issued with radar sets for use in navigation.

Scientists, Government Departments, and shipping interests recently decided on a general purpose set suitable for merchantmen, and the Ministry of War Transport is arranging for its manufacture.

November 1970

Satellite studio in Tasmania: Tasmanian radio station 7LA opened a satellite studio in Georgetown earlier this year.

It is claimed to be the first occasion when a commercial station on the island has broadcast regularly each day from a permanent studio with resident personnel more than 30 miles from its main studio.

The audio equipment at Georgetown is fully transistorised, of modular construction and designed for minimal maintenance.

The prototype console has been operated for almost six years without any component change.

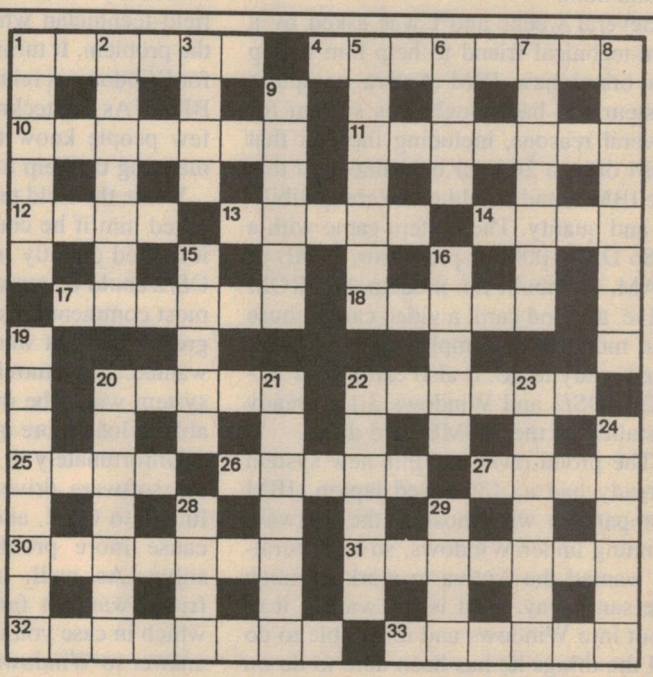
Pocket VHF radio: A pocket size VHF transceiver operating off a rechargeable nickel-cadmium battery has been developed in the UK by Rank Precision Industries for police, fire and similar services. The units uses a combination microphone/loudspeaker unit which can be clipped to a harness to leave the hands free for other tasks. The harness, available in either lightweight Terylene or all leather, incorporates a dipole antenna in the shoulder strap.

Ferromagnetic detector: A battery operated magnetic measuring instrument has been designed to detect concealed weapons without revealing that a search is in progress.

The device, a magnetic gradiometer, consists of a small unit which can be placed in an inside coat pocket, a sensor probe which straps to the forearm, and an earphone similar to that of a hearing aid.

When the sensor is brought near a magnetic object, a whistle is heard in the earphone. The pitch increases in proportion to the size and proximity of the object. ❖

EA CROSSWORD



ACROSS

1. Electrically erasable programmable read only memory. (6)
4. Information service, the ---- board. (8)
10. Display of information. (7)
11. Deflecting components of CRO. (1-6)
12. Electronic gaming system (abbr.) (4)
13. Brilliant German physicist and mathematician (1777 - 1885). (5)
14. Unit of data. (4)
17. Charged particle. (6)
18. Transient current. (5)
20. Component of an item of data. (5)
22. Raise to higher energy state. (6)
25. Sound signal of single frequency. (4)
26. Source of gold, etc, in tabular deposits. (5)
27. Commercial use for neon. (4)
30. Indicating instrument. (7)
31. Device used for battery maintenance. (7)
32. Alloy used as heating element. (8)
33. Inventor of gyroscopic compass. (6)

SOLUTION FOR OCTOBER 1995

D	A	T	A	B	A	S	E		I	R	V	I	N	G
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S	I	G	N	A	L		M	E	G	A	B	Y	T	E

DOWN

1. Mistakes in printing. (6)
2. Colloquial term for vinyl recording. (7)
3. Musical instrument. (4)
5. ESA's solar research spacecraft. (7)
6. Quiet period. (4)
7. Type of thermionic valve. (7)
8. Aerobatic manoeuvre. (8)
9. Stress measuring instrument, the ---- gauge. (6)
15. Raised platform for speakers. (5)
19. Co-inventor, with Bardeen and Shockley, of the transistor. (8)
20. Quality specified for recording tape, the ---- range. (7)
21. Mathematical statement. (7)
22. Phenomenon occurring as result of some cause. (6)
23. Initiate operation of electronic circuit. (7)
24. Capacity to do work. (6)
28. Object used in certain navigation. (4)
29. Source of light. (4)



INFORMATION CENTRE

by PETER PHILLIPS

When supposedly compatible things aren't...

As the title suggests, this month we raise a few issues about incompatibility. We also look at some unusual transistor parameters, a scheme to simulate moonlight, how to regulate the voltage of a simple solar power system and more.

These days most technical people use a computer, or at least are computer literate. And whether we like it or not, the IBM compatible is pretty much the standard, so it's reasonable to say most technical people have a knowledge of the IBM compatible computer. But I wonder how many readers are familiar with an actual IBM personal computer, and not just a compatible. What's the difference, you say? Quite a lot, as I recently found out...

Several weeks ago I was asked by a non-technical friend to help him set up his brand new IBM Aptiva computer system. He had bought this system for several reasons, including the fact that IBM offer a 24-hour help line, and that the IBM brand would mean compatibility and quality. The system came with a '486 DX4 100MHz processor, 16MB of RAM, an inbuilt fax modem, CD-ROM drive, a sound card, a video card, mouse and monitor. A complete system packaged ready to go. It also came with PC-DOS, OS/2 and Windows 3.11 already installed on the 720MB hard disk.

The proud owner of this new system already had a '486-based laptop (IBM compatible) with most of the software running under Windows, so he naturally wanted the Aptiva to work in much the same way. That is, he wanted it to boot into Windows and to be able to do all the things he has been able to do on the laptop. As the system stood, it booted into a menu that offered OS/2, Windows or DOS, with a total time to actually get into Windows of nearly two minutes, compared to a more typical time of 30 seconds.

My first task was to set the Aptiva so Windows ran in SVGA (1024 x 768) video mode, rather than the basic VGA mode. This is usually quite easy to do, and simply involves installing a video driver through the Windows Setup routine. Not so on the Aptiva!

After about an hour of fruitless attempts, I contacted the IBM help line. After a further hour, the IBM technician decided that he really didn't know how to do this, and promised to call back the next day with the answer. As this didn't eventuate, the owner asked around and eventually made contact with an IBM field technician who was able to solve the problem. It turns out the video mode for Windows is related to a setting in the BIOS! As the technician admitted, very few people know this, including those manning the help line.

While the field technician was there, I asked him if he could set the system so it booted directly into Windows, and if OS/2 could be removed. After all, while most commentators agree that OS/2 is a great system, it was not what the owner wanted. By removing it, we hoped the system would be more manageable and able to load more quickly.

Unfortunately it seems virtually all the software drivers are in some way linked to OS/2, and removing it would cause more problems than it would solve. As well, our IBM technician friend was not familiar with OS/2 — which in case you don't know, is IBM's answer to Windows.

I later tried to install some Windows fonts to supplement the four basic fonts currently installed. Again to no avail, but this time the IBM help line was able to solve the problem. I wonder what will happen though when we try to do more sophisticated things, like installing MIDI drivers for the sound card.

As you can see, I'm not impressed. It seems IBM have still not shaken off the mainframe mentality and are producing a personal computer that even IBM staff don't understand. Internally this particular model looks like no other computer I've ever seen, and setting it up is a nightmare, all because IBM do it differently to everyone else. Considering IBM invented the PC, displacing Apple and virtually all other manufacturers from the home computer market, it seems odd that 10 years or so later IBM's own PC is the least compatible of all!

PAL versus NTSC

Staying with compatibility as a subject, here's our first letter. It's from a reader seeking information about NTSC and PAL and, of course, their incompatibility...

Could you print an article on PAL and NTSC television signals? Are the NTSC and PAL signals generated by a TV camera or a video tape recorder? Can the same video camera be used on each system, or do you need one camera for PAL and another for NTSC? How do you convert the NTSC signal to PAL and the PAL signal to NTSC?

If you have an NTSC camcorder, how do you convert the NTSC signal to PAL so you can watch a colour picture on a PAL TV. Is there a kit I can get that will do this, or could EA bring out a suitable kit? (Robert Mills, Matraville, NSW.)

Phew! That's quite a few questions, Robert. I'll try and answer them after the next letter, which seeks similar information:

PAL to NTSC conversion

I am hoping you can solve our video problem. I have several VHS tapes recorded here in Perth WA, and I would

like to send them to my relatives and friends in Manila. But there is a problem of different AC power frequencies, as the Philippines supply voltage is 220 volts at 60Hz, compared to Australia's 240V at 50Hz. As well, VHS tapes produced in the PAL system are not compatible with the NTSC video system used in the Philippines. PAL video tapes can only be watched if they are first converted here in Australia to an NTSC format.

What I need is an electronic device or appliance similar to a voltage transformer which can convert the 60Hz 220V in Manila to a 50Hz frequency so a VCR and TV set in Manila can temporarily receive 50Hz video signals. With this frequency converter, Australian pre-recorded tapes, PAL computers, PAL computer games, and Australian TV satellite broadcasts could be viewed in Manila. (Edgardo Rivera, Craigie, WA.)

Oh that it were that simple, Edgardo. You are quite right in relating power supply frequency to a TV picture, but only for one aspect — the frequency of the vertical oscillator. I've never understood why we have this relationship, as it often causes problems with vertical synchronisation.

In fact you need considerably more than a simple frequency converter to convert a PAL signal to NTSC, mainly because of the different ways of encoding the colour information. As well, the vertical frequency for NTSC is 60Hz compared to 50Hz for our PAL, and 15.750kHz for the horizontal frequency compared to 15.625kHz for PAL.

You can see that these frequencies are not all that different however, and if the TV set can synchronise to them, a PAL signal can be seen on an NTSC receiver; except it's in black and white. An NTSC signal can also be viewed on a PAL receiver in the same way.

But converting the colour information requires a lot more. There are PAL-NTSC standards converters available, but mainly in the professional market place (and they're not cheap). We have never described such a device, and I doubt if we ever will as it is really quite complex. We can only refer you to one of the suppliers: AV-COMM Pty Ltd, PO Box 225, Balgowlah 2093; phone (02) 9949 7417, or fax (02) 9949 7095.

Returning now to Robert's questions. The colour encoding process in both PAL and NTSC requires three colours (red, blue and green) to be combined into one signal that is then integrated with the video signal. In a portable video camera, this is all done inside the camera. A VCR doesn't generate these signals, it simply records them.

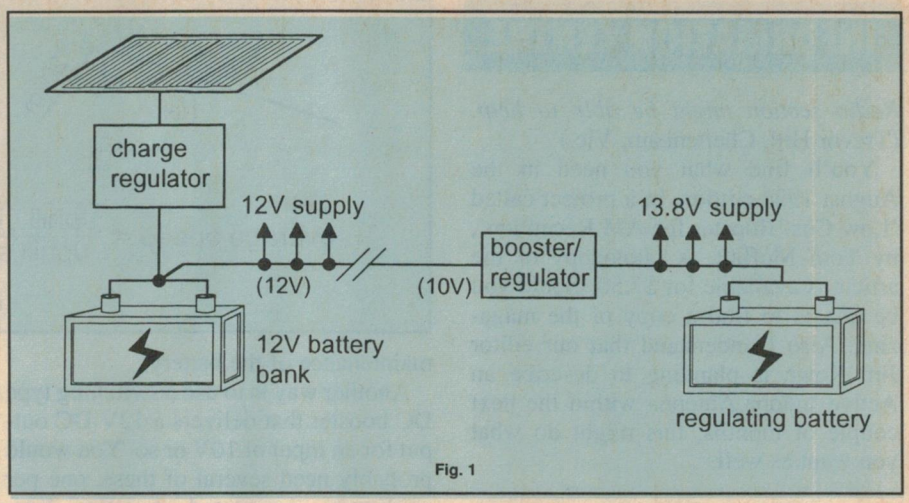


Fig. 1

The main differences between PAL and NTSC colour are the subcarrier frequency and the encoding process. The subcarrier frequency for PAL is 4.433MHz, while standard NTSC uses 3.58MHz. The higher frequency for PAL allows a wider bandwidth for the video information, which gives a sharper picture and more detail.

The encoding (and therefore decoding) process for PAL is *based* on the NTSC system, and was known when NTSC was first introduced. The problem was the technology did not exist at the time to produce an essential PAL component, called the colour delay line. Being impatient, the US and other countries went ahead with NTSC (often jokingly said to mean 'Never Twice the Same Colour!), while the rest of the world waited until technology caught up with the theory.

For PAL, the colour information for each alternate scan line of the TV picture is phase reversed, hence the term Phase Alternate Line (PAL). When this information is corrected by the colour decoder, it also cancels out phase errors that otherwise give wrong colours.

The PAL delay line gives a delay of 64us (one period of the horizontal oscillator) to allow the colour information of one line to be added to another, thereby giving the required cancelling effect. Complicated? Sure is!

There's more to it of course, including two standards for NTSC, called 3.58 and 4.33, which refers to the subcarrier frequency. The problem is unlikely to ever go away, as countries using NTSC will argue the huge expense of changing to PAL, and those used to the PAL system will not want to go backwards to an inferior system.

Fortunately, many TV receivers on the market today can accept either PAL or NTSC signals, and VCRs able to play and record both systems are now available for $800 or less. But don't be fooled into thinking that such a VCR actually converts one colour system to another. I'm not sure if there *is* such a VCR available on the domestic market; perhaps a reader could advise me. So Robert (and Edgardo), there's not much we can do for you, other than explain the problem.

We move now to radio, and this time we *can* help.

Vintage AM radio reception

I've described various ways of improving AM radio reception in this column, but so far not for radios made in the 1920s. While this might not be a common problem, it is for our next correspondent:

I am writing in regard to a project which I believe was published in Electronics Australia some years ago. The project was an amplifier for the AM broadcast band, which would enable vintage radios from the 1920s to be operated without the need for a long-wire antenna. I live in an apartment which does not allow me to set up such an antenna, and thus I cannot operate my TRF and regenerative receivers.

I would appreciate you searching your records for such a project, with a view to getting a reprint of the article. If such a project has not been described, then perhaps it could be considered for a future article. Alternatively, perhaps one of your contributors to the Vintage

Radio section might be able to help. (Trevor Hill, Cheltenham, Vic.)

You'll find what you need in the August 1994 edition, in a project called 'Low Cost Booster for AM Reception', by Tom Moffatt. A photocopy of the article is available for $7.50 should you be unable to find a copy of the magazine. Also I understand that our editor Jim Rowe is planning to describe an Active Indoor Antenna within the next couple of months; this might do what you want as well.

Solar power

The next letter is from a reader with a problem concerning a simple solar power system:

Some people run small, therefore limited solar power systems, which is a topic rarely discussed in electronics magazines. My system is 12V rather than 24V, as the equipment I use with it is rated for 12V. For a system running 240V AC appliances, 24V is the way to go, but in my case it would be wasteful.

Unfortunately, the cable from the battery being charged by the solar panel to my house develops a voltage drop of 2V or so, giving about 10V when fully loaded. This means I can't use my portable colour TV set, as it needs 12V to operate. To overcome this I have connected a boost type solar battery charger to the line, so it is charging a 12V battery. The purpose of this battery is to regulate the output voltage of the charger. This is one solution, can you better it? (Ian Thay, Carnegie, Vic.)

Ian's solar panel setup is shown in Fig.1. Of course the obvious question is the gauge of the supply lines, but I assume you have already thought of this. The boost/charge regulator you are using is probably a switching type, designed to work with a 12V battery. Without the battery, the output voltage is 20V or more and regulating the output voltage with a linear voltage regulator simply wastes power.

In terms of efficiency and cost effectiveness, your solution to the problem seems to be both practical and sensible. There is only a small loss in the booster/regulator (I assume); the regulating battery keeps the output voltage constant, and it also acts like a capacitor to store and deliver power as required. About the only problem I see is the maintenance of the battery.

Another way is to use a switching type DC booster that delivers a 12V DC output for an input of 10V or so. You would probably need several of these, one per appliance connected to the line. Unfortunately I can't refer you to a design of such a regulator. So Ian, in the absence of such a device, I really can't better your method.

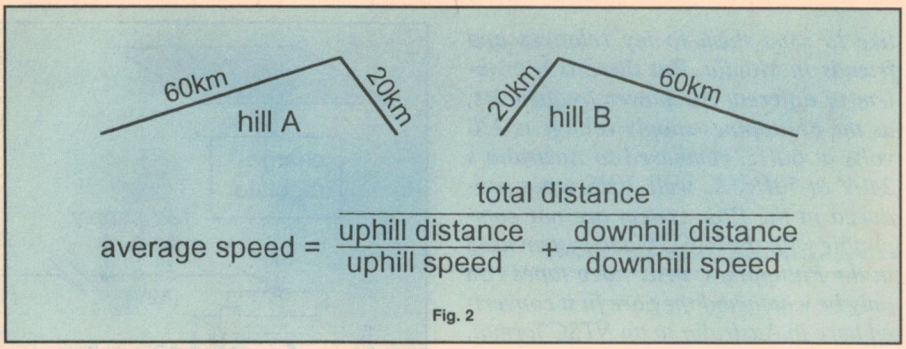


Fig. 2

Unknown parameters

The next letter discusses two little known parameters about transistors, including one that caused a problem for aircraft beacons:

I am writing to recount a story that might interest you and your readers. It concerns the dependence of the base current on the collector current of a transistor — a parameter that once cost the Department of Civil Aviation (now defunct) much anguish and money. As a simple experiment to see this, connect up a transistor with an ammeter in the base lead, in series with a variable resistor and a battery connected to the emitter. Set the meter to one milliampere, to avoid overloading the base-emitter junction.

Connect a similar network between the collector and emitter, using an ammeter able to read up to 100mA. If you vary the collector current, you'll see that the current in the base-emitter junction will drop as the collector current increases, and vice versa.

Now imagine the final on a transmitter in which the collector supply is modulated (Heising?). On the negative peaks there is no collector current, so what happens to the base current? You guessed it, and several non-directional beacons (NDBs) failed before the penny dropped and base modulation was also applied.

Incidentally, nobody seems to realise that in common emitter mode, a transistor is an avalanche device. The current in the emitter-base junction causes a current of about 90% its value in the base-collector junction. This current must come through the emitter-base junction which again, through the original emitter-base mechanism, causes the collector current to rise and so on.

While very fast, it still takes a finite time to occur, and a graph showing this would resemble that of the rising charge voltage of a capacitor, probably accounting for the transistor sound of early transistor radios. (L. Cross, Newtown, NSW.)

These are two interesting aspects of a transistor, and thanks for pointing them out Mr Cross. Your story concerning the NDBs certainly illustrates the presence of a relationship between collector current and base current. A better known parameter is the relationship of current gain (beta) and collector current, in which beta drops as the collector current increases. This was often cited as a reason for `transistor sound'.

Regarding the rise time of the collector current, which in effect is what you're describing in your second point, I doubt if it explains a `transistor sound,' as most audio waveforms would have a much slower rise time. It certainly becomes important when a transistor is used in a switching application, which is why switching transistors are made.

May's What??

The next letter is about the May What?? question, or more particularly, the answer. The question asked for the average speed of a solar car, given it averaged 20kph up a hill and 60kph down the other side. The answer is not found by averaging these two speeds, and works out to be 30kph. However, this might not be the whole story...

It is with much pleasure that I have read RTV&H and EA each month since the '50s. Thank you personally for an engrossing column.

A few comments on your answer to the May What?? question, which shows that the solution is not the average of the two speeds. Your answer is quite correct if

one assumes that the uphill and the downhill distances are the same, but we are not told this. I have derived an equation to solve the problem (see Fig.2) and if you put your figures into this equation, you will get the answer you presented.

Let's assume the vehicle is travelling over hill A in Fig.2. Here the uphill distance is 60km and the downhill distance is 20km. Using your speeds of 20kph and 60kph respectively in this equation gives an average speed of 24kph. For hill B, the distances are now 20km and 60km, and the average speed works out at 40kph.

A different answer will appear for each different combination. Thanks for an interesting exercise, keep up the good work. (Jim Ablett, North Geelong, Vic.)

Thanks Jim, for the nice comments and for your discussion of the question. I agree with you that the answer I gave is not definitive, as the assumption that the uphill and downhill distances are the same cannot be made.

As I said in May, I derived the question from a book of puzzles by C.R. Wylie Jr. The original question makes no mention of the uphill and downhill distances, and the answer given is the same as mine. So obviously Mr Wylie also assumed equal uphill and downhill distances. I wonder how many readers did the same!

Alternator regulator

The next letter seeks help about a regulator for a Davies alternator.

I recently rescued an old generating set from a scrapyard. It turned out to be a 225cc BSA stationary motor powering a Davies alternator. I cleaned the alternator and found it to work well.

My problem is regulating the output to obtain a stable 230V. Whatever regulator it once had is long gone. I have priced new electronic regulators (they must be gold-plated!) so I am looking for an alternative.

I understand these alternators once used a variable resistance carbon pile setup that was solenoid activated. In this high-tech age, is it still possible to buy and use a simple regulator based on this idea? Alternatively could I build a voltage regulator myself? I can't find a circuit diagram of such a device, but perhaps you or a reader could help.

The Davies alternator has four fixed field coils and a rotating armature. It is single phase and turns at 1500rpm. At a guess, the power output is up to 1500VA, but so far I have only used 12V across the field coils giving an output of about 600VA. (Allistair Brooker, c/o Post Office, Paroa, Greymouth, NZ.)

I've included Allistair's address, in case a reader can help with a circuit diagram. The principle of such a regulator is quite simple, and would be similar to that used in a car alternator, except the output voltage is higher.

In principle the output voltage is sampled by the regulator and the field current is controlled accordingly. This should be easy enough to do with transistors, as you don't need to sample the full 230V output. A problem is controlling the field current, as there could be quite a lot of heat generated by a series transistor. A better way is a switching circuit, where the frequency of the switching action is varied according to the output voltage.

Still, while the principle is easy to explain, an actual circuit is much better. Hopefully someone can help Allistair.

Simulated moonlight

I've extracted the next topic from a letter sent by a reader who had a number of ideas for projects. We haven't space to list the suggested projects, but I think you'll find this part of the letter thought provoking:

Here's something different. Now that we have the technology, I suggest science considers putting into space a large reflective surface to reflect the sun onto the earth during night time, like the moon does.

If we could simulate moonlight every night, we could turn down street lights, lessen burglaries at night, cars could drive with reduced lighting, security lighting could be reduced and so on. Of course we would need to consider the effect this might have on plant life, animals and people, but it would sure save energy, and possibly the environment as well.

Incidentally, we don't get moonlight on Earth, instead we get reflected sunlight. If you shine a torch onto a mirror, the reflected light is not called `mirror light', it's torch light. The moon is simply an object that reflects sunlight, it doesn't produce its own light. (Graeme Wilson VK6BSL, Kingsley, WA)

An interesting idea Graeme, although one that might stretch the technology. From an ecological point of view, I wonder how much energy would be saved in terms of a percentage of the total. When you realise that a fully loaded electric train takes about 2MW of power to get going, we might do better concentrating on these `big ticket' items, rather than lighting.

Still, having simulated moonlight (sunlight) all year would be attractive to many people, as it would quite likely reduce crime at night. It could also reduce car accidents, and improve our lifestyle. Of course not everyone would want year-round moonlight, but it would be interesting to research the issue.

What??

I'll let the contributor for this month's question introduce it. It comes from Peter Hadgraft, Holland Park, Qld:

Here's a simple question after all those difficult op-amp questions. I first struck it on the Quiz Kids with John Deese, sometime in the late '40s or early '50s.

I run a 40,000km lead around the Earth's equator, laid flat on the ground. I now raise it all over so the lead is now one metre above the ground. How much longer does the lead need to be?

Answer to October's What??

The answer is 18V. If M = 24V, then from the information given two equations can be developed: (1) M - x = A and (2) M = 2(A - x), where x is the difference between the two voltage sources. Substituting 24 for M gives: (3) 24 - x = A and (4) 24 = 2(A - x). Substituting (3) into (4) gives 24 = 2 (24 -x -x) which simplifies to 12 = 2x, so x = 6. Substituting for x into equation (3) gives 24 -6 = A, which gives us the answer of A = 18V when source M is 24V. ❖

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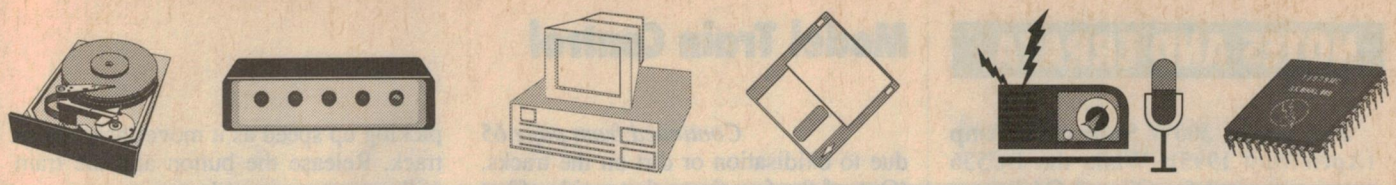
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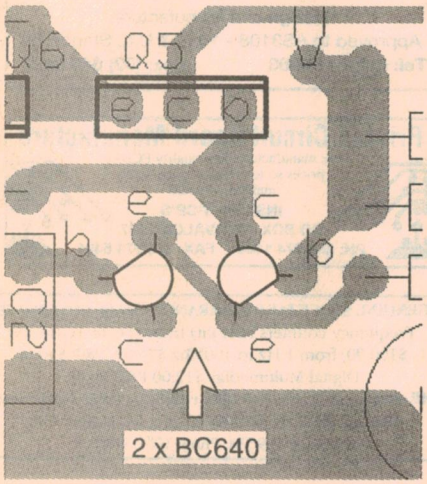
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NOTES AND ERRATA

Playmaster 300W Subwoofer Amp (April/May 1995): While the BC556 transistors used for Q3 and Q4 have a 'nominal' rating of 80V they can suffer from voltage breakdown in some amps, resulting in an audible 100Hz hum or even 'motor-boating' at the output. The BC556 transistors can be replaced by BC640s (which have a higher voltage rating) as indicated in the associated diagram.



Model Train Control

Continued from page 65

due to oxidisation or dirt on the tracks. (One of the few times that a side effect has a *beneficial* effect!) So the addition of the bulb makes the train run much more smoothly at lower speeds — great for shunting.

The bulb can be mounted somewhere on the layout, providing a visible indication that something has shorted across the track.

Getting up 'steam'

Connect a suitable transformer to the controller — if you already have an existing multi-tapped transformer, then by all means use it, but if not, a suitably rated AC plug pack will fit the bill nicely.

Before you go any further, check *everything*. Pay special attention to the wiring to and from the controller, as well as checking for any shorts. When you are happy with everything, place an engine on the tracks, set the Throttle to say mid position, shout 'All Aboard!' and press (and hold) the 'GO' button.

The engine should soon come to life, picking up speed as it moves around the track. Release the button and the train will come to a smooth stop.

After you've played around with this for a while, try pressing the 'Emergency Stop' button while the train is motion. The engine will come to a sudden screeching halt — quite dramatic when you are used to the inertia simulated by the controller. (In fact you soon start to see the inertia as *real* and part of the train, rather than being produced artificially by the controller.)

The two trimpots RV2 and RV3 are the presets for the acceleration and deceleration respectively; they should be set to give a realistic amount of inertia and momentum for the gauge train you are using. If you find that they don't give you enough range (particularly with larger or longer trains), you can increase the value of C1 to a couple of hundred microfarad.

This will give you much longer acceleration and deceleration times. Also the choice of light bulb will change the starting and stopping times significantly, so it would be best to make any adjustments after the bulb has been installed. ❖

NEW KITS FOR EA PROJECTS

FROM JAYCAR ELECTRONICS:

Induction Loop TV Headphones (October 1995): The Jaycar kit is for the pickup unit alone, and is complete with PCB, utility box, ferrite rod and all electronic components apart from the battery. It has Cat. No. KA-1779 and is priced at $19.95. Four-core cable (WB-1620) is available for installing the induction loop.

FROM DICK SMITH ELECTRONICS:

Train Controller with Simulated Inertia (November 1995): The DSE kit is complete as described (no transformer or plug pack), with PCB, case, ferrite rod and all electronic components. It has Cat. No. K-3027 and is priced at $34.50.

NOTE: This information is published in good faith, from information supplied by the firm(s) concerned and as a service to readers. Electronics Australia cannot accept responsibility for errors or omissions.

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UNSW PHYSICISTS USE LOW COST LASER TO MAP FLAWS IN SEMICONDUCTOR WAFERS

SONY DEVELOPS FLAT PLASMA SCREEN FOR LARGE DISPLAYS

USING THE MICROCHIP TECH PIC16C84 SINGLE-CHIP MICRO



NEW DOUBLE SPEED PORTABLE CD-ROM DRIVE FROM PANASONIC CONNECTS TO LAPTOPS VIA A PCMCIA CARD, OR DESKTOP PC'S VIA A SCSI 2 INTERFACE

NEWS HIGHLIGHTS

UNSW LASER MAPS SEMI WAVER FLAWS

Two physicists at the University of NSW have produced a simple laser instrument able to map the distribution of damage or other variations in the composition of semiconductor materials.

Using a technique known as differential reflectance spectroscopy, Mr John Tann, a Professional Officer in UNSW's School of Physics, and Associate Professor Michael Gal, Head of the Department of Condensed Matter Physics, have produced an instrument that operates at room temperature and in a normal atmosphere and does not damage the object being analysed.

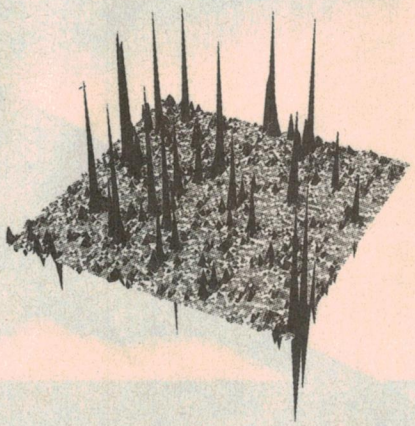
The device works as well on opaque and highly reflective materials as it does on transparent materials and is able to gather data that other optical techniques cannot detect. It can detect variations in composition as low as one part in 100,000, and currently has a resolution of two microns.



The two researchers are hoping to find a scientific instrument maker interested in developing their instrument for commercial markets. In the meantime, they are working on improving its resolution.

Because the device is particularly well suited to mapping defects in commercially important semiconductor devices, including silicon and more exotic devices using gallium arsenide, aluminium gallium asenide, indium phosphide and gallium indium arsenide (known generically as III-IV compounds), it could have a strong demand in the semiconductor industry, and also in the potentially huge thin-film photovoltaic solar energy industry.

Most semiconductors and the highly promising thin-film solar cells require silicon or another semiconducting material to be 'doped' with other compounds to increase their performance. Although only small amounts of these dopants may be required (say one part in a million), it is important to know exactly where in the device the dopant has accumulated — what depth it is and how evenly it is distributed.



A differential reflectance map of a 1mm square sample of silicon after doping with boron. The peaks and troughs represent inhomogeneities in the crystal structure. (Courtesy of John Tann.)

One of several advantages of the Tann/Gal instrument is that by tuning the wavelength of the laser, the depth can be varied at which the variation in composition is mapped. This means it can build up a three dimensional profile of the device, which few other techniques can, regardless of cost or complexity.

Professor Gal said that the advantage of this application of differential reflectance spectroscopy over similar techniques such as electro-reflectance and photo-reflectance was that the signal increased with increasing damage or inhomogeneity in the material while the signal in other modulation techniques declined rapidly with increasing damage.

The instrument's laser light source is provided by a titanium sapphire laser or a helium-neon laser, depending on the depth of penetration required. The laser beam is passed through a series of optical devices before it is focused onto the sample, which is made to oscillate in the focal plane of the focusing lens.

This oscillation, at 600Hz is necessary to generate the differential reflectance signal, which is reflected back through the focusing lens and is then diverted by a semi-transparent mirror to a computer for processing.

John Tann said that the device was easy to operate and because it was also a relatively simple system, it had the ability to gather important data on semiconductor devices at a fraction of the cost of other systems. "We see this device as particularly useful for manufacturers of semiconductors or other devices which need to check quickly and easily the quality of their products," he said.

100 YEARS OF X-RAYS

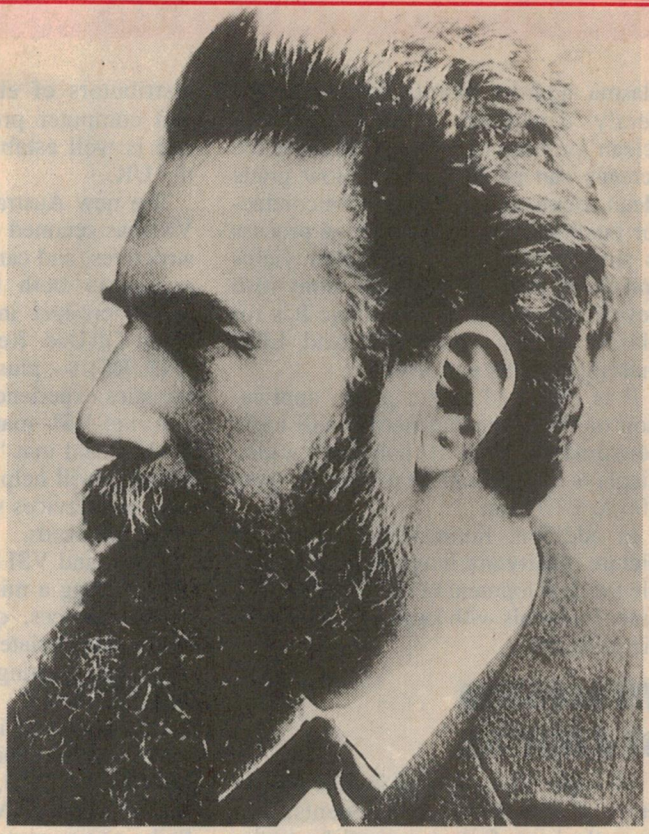
November 1995 marks the centenary of the discovery of X-rays, by German physics professor Wilhelm Conrad Röntgen.

Born in 1845 in the town of Lennep, near Dusseldorf, Röntgen was working in a room of the Physics Institute at the University of Wursburg. He was experimenting with discharge tubes, and on the evening of November 8 he had placed a cardboard box over a tube to ensure that no external light fell on it. When he switched on the induction coil powering the tube, he noticed that a glow was emitted from a nearby bowl-shaped glass dish coated with special chemicals. Deducing that this must be due to some kind of radiation coming from the tube, he tried placing his hand between the two — and immediately saw only an image of its bones.

This was not only the first known manifestation of X-rays, but also a dramatic demonstration of their potential value for mankind. Röntgen was soon able to take an X-ray photo of his wife Bertha's hand (complete with wedding ring apparently 'floating' around her finger bones), and when published this and his discovery made him famous around the world.

Despite the publicity his discovery achieved, Röntgen was a shy and reclusive man who made no attempt to use the invention for personal gain. He was awarded the Nobel Prize for Physics in 1901, but died in 1923 impoverished by post-WW1 inflation.

Today he is acknowledged as one of the great natural scientists, as his discovery was crucial in allowing physics to enter the modern 'atomic' era.

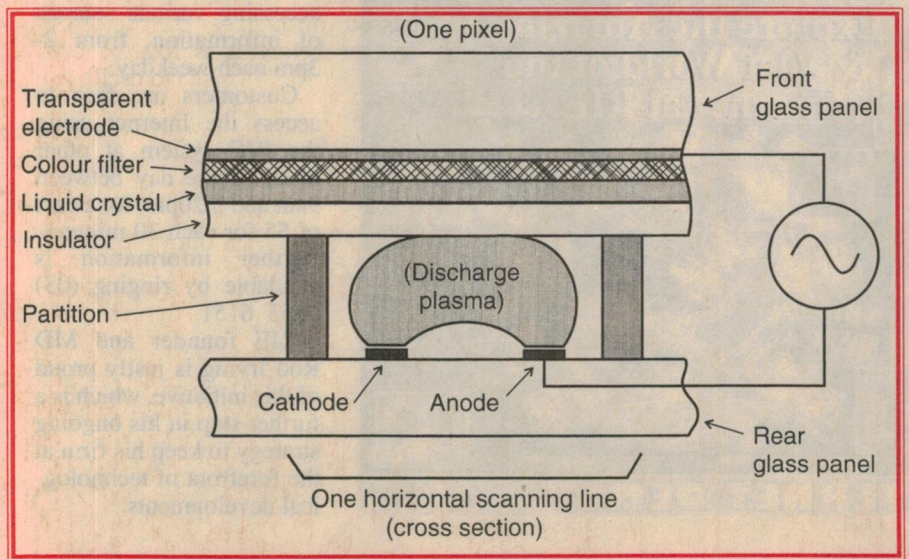


SONY DEVELOPS FLAT PLASMA SCREEN

Japan's Sony Corporation has developed a flat panel colour display for large screen use, tentatively named the Plasmatron. The display is based on the plasma-addressed liquid crystal (PALC) technology jointly developed with US firm Tektronix Inc, and features high brightness, high contrast and clear picture quality.

The display is an active-matrix system that separately addresses each pixel of the liquid crystal, allowing a very wide range of colours and smooth replay of moving images.

The PALC technology used for pixel addressing uses plasma as an electronic switch, rather than as a source of light. Each single scanning line is served by a single channel filled with low pressure gas, with the complete image formed using around 450 of the horizontal plasma channels in a vertical array. This makes for a relatively simple structure that is suitable for large and lightweight screens.



Each plasma channel contains a linear array of anode and cathode electrodes, on its transparent rear plate. Within the channel each individual electrode pair can be addressed to produce a small localised plasma discharge, which when established provides an effective electrode for coupling to the liquid-crystal pixel on the front of the channel's transparent front plate.

In front of the liquid crystal layer is a vertical array of RGB colour filter stripes, topped by a further transparent electrode and the main protective glass panel (see diagram). The actual light source is a common backlight for the entire image.

Current prototype plasma displays measure 634mm (25") diagonally and provide a resolution of 448 lines by 768 pixel trios, in a 16:9 widescreen aspect ratio. The individual pixel trios measure 0.72mm wide by 0.69mm high. The maximum brightness level is 250cd/m^2, with a contrast ratio of 50:1 and 260,000 possible colours.

The overall panel dimensions are 602 x 380mm with a depth of only 3.7mm including deflection panel, and a weight of 1.7kg.

To facilitate the multi-layer printing process needed in producing the panel's

plasma address board, Sony independently developed a high precision 'clean' printing technology. Because the screens can be produced in low grade clean rooms rather than in semiconductor facilities, the manufacturing process is simpler and results in higher yields and lower costs. In addition, Sony also developed special high voltage ICs for plasma switch addressing and LCD incremental current drive.

It is expected that a prime application of the Sony Plasmatron will be in consumer-use 'wall hanging' video displays in diagonal sizes ranging from 500 to 1270mm.

In addition, future developments in picture quality are likely to make possible the development of multimedia computer terminals with large yet space-efficient displays.

VSI ACQUIRED BY AVNET INC

VSI Australia, the well known distributor of electronic components, has recently been fully acquired by major US distributor Avnet Inc. Avnet is based in New York, is listed on the New York Stock Exchange and has annual sales revenues of approximately A$6 billion. It is one of the largest distributors of electronic components and computer products in the world, and is well established in Europe and the UK.

The new Australian company Avnet-VSI has retained all local management structures, and can now offer customers access to both the US$600 million Avnet product inventory and Avnet's Point-Of-Use Replenishment System (POURS) — plus its warehousing and logistics experience.

Avnet-VSI managing director Bob Crabbe said that "The Avnet-VSI combination will help us to introduce products and services very much in line with customer needs.

Avnet and VSI share common beliefs in providing a mix of value-added customer services, quality and inventory levels appropriate for the local market. This is an exciting new phase for us and our customers."

Headquartered in Sydney with offices in all major capital cities, Avnet-VSI handles AMD, Hewlett-Packard, AVX/Kyocera, Motorola, Harris and Seiko components.

CYBEC EXPANDING

Melbourne-based computer security specialist Cybec, well known for its very successful VET anti-virus package, has entered a period of expansion. It has opened an office in Sydney, to provide local sales and support for VET users and resellers.

The new Sydney office has been set up by Rob Stroud, Cybec's new Manager of Corporate Development, who joined the company recently and was formerly an IT project manager with the Commonwealth Bank. The office is located in Alexander Street, Crows Nest; phone (02) 965 7216.

Andrew Endersbee, formerly Trade Marketing Manager for Cadbury Schweppes, has also joined Cybec as its new General Manager.

Cybec now claims to be Australia's leading producer of anti-viral software, with its VET package used on over 130,000 PCs both in Australia and in 10 other countries.

The company had a turnover of over $2.4 million for 1994-95, more than double that for the previous financial year, and has a staff of 20.

Cybec founder Roger Riordan wrote the original VET in 1989, while a lecturer at Chisholm Institute of Technology.

The company has just released VET_NET. NLM, a network loadable

RIE SETS UP INTERNET DEMO

Despite all of the media hype concerning the Internet, many technical people — including those with personal computers and modems — are still unsure of its potential direct value to themselves, and have deferred linking up. To assist such people and help them in making an informed decision, Melbourne-based electronics retailer Rod Irving Electronics has set up a demonstration Internet linked system at its city store (48 A'Beckett Street).

The advantage of the demo system is that it allows any interested person to get direct 'hands on' experience of Internet functions and resources — experience that can never be provided by reference books or magazine articles.



RIE staff experienced in accessing the Internet are on hand to provide help for those who need it, and also provide demonstrations of the exact step-by-step procedures involved in accessing various sources of information, from 2-3pm each weekday.

Customers are free to access the Internet using the RIE system at other times of the day between 9am and 5.20pm, for a cost of $5 for each 30 minutes. Further information is available by ringing (03) 9663 6151.

RIE founder and MD Rod Irving is justly proud of this initiative, which is a further step in his ongoing strategy to keep his firm at the forefront of technological developments.

IMP RISEN FROM THE ASHES

IMP Engineering, a widely respected South Australian manufacturer of PC boards, suffered a major set back when their Adelaide base facility was totally destroyed by fire in 1994. However after only eight months, the company was back into full production at its new site.



Immediately after the fire, responding to customer demand, jobs were subcontracted out to other PCB manufacturers. At the same time a temporary production facility was set up in a disused warehouse that IMP's parent company, Codan, had leased. In addition to these arrangements, and as an example of the support the company received from both customers and competitors, the day after the fire the Defence Science & Technology Organisation in Adelaide offered IMP a lease on their PCB manufacturing facility to get production under way again.

Now, with the traumatic episode behind them, IMP have re-established in a larger facility and in a new location. Some three times larger than the old factory, IMP's new facility is an architecturally designed warehouse within an expanding technology area of Adelaide. To date several million dollars have been spent in the conversion. The latest technology has been installed to maintain the company's position as a premier supplier of quality PCB boards.

A new Gerber laser photoplotter has been installed, increased capacity especially in more reliable prototype services, as well as improving accuracy and resolution.

A fully automated electrolytic copper/tin plating line has recently been commissioned.

The hardware combined with the software, specifically developed for IMP are said to provide complete control of the process, ensuring the highest product quality and repetition.

IMP Engineering can now offer its loyal customer base, as well as potential customers, an improved manufacturing and support service backed by a quality assurance system that totally complies with AS/NZS ISO 9002 accreditation.

module compatible with Novell 3.X and 4.X systems, to provide server protection against PC viruses.

COURSES IN MICROELECTRONICS

Brisbane's Griffith University has what it claims is Australia's first School of Microelectronic Engineering, headed by Professor Barry Harrison.

The School is now offering its inaugural professional development courses for a wide range of professionals, including electronic and electrical engineers, computer scientists, scientific officers, technicians, design and process development engineers and teachers.

Professor Harrison explained that the courses have been set up as a response to the need for electronics and microelectronics professionals to keep abreast with new technology.

"Microelectronics technology is revolutionising the way we live and work, and is changing rapidly", he said. "The courses will equip professionals with some of the latest technological skills and training available in Australia today."

The courses are sponsored by the School's highly successful Industrial Affiliates Program (IAP), and aim to build upon the cooperative relationship with industry formed over the last three years by that program.

The Professional Development Courses will be conducted at Griffith University, but can be provided in-house and tailored to the specific needs of an organisation if required.

Further information is available from Carol-Joy Patrick at the university; phone (07) 3875 5007.

INTEL EXPANDING IN IRELAND

Leading US microprocessor maker Intel is expanding its European production facilities in Ireland, with a £900 million addition to its wafer fabrication plant in Leixlip, County Kildare. This represents a major expansion of the plant, as Intel had invested £650 million in it previously.

One of the existing Leixlip facilities produces half of the Pentium chips used worldwide, while another recently opened a £13 million extension for PCB production and computer systems assembly. Intel Ireland currently has 1800 full-time and 400 part-time employees. ❖

NEWS BRIEFS

- The distribution of JBL professional products in Australia is still being handled by ***Jands Electronics***, but ***Convoy International*** is now handling JBL consumer products.
- Weiss Technik, represented in Australia by ***Spectra-Physics***, has announced the takeover of environmental test chamber manufacturer Heraeus Votsch.
- A two day seminar called Marketing and Advertising on the Internet, organised by ***AIC Conferences*** will be held in Sydney, November 15 and 16. For further information phone (02) 210 5700.
- ***Mike Boorne Electronics*** has moved to Unit 11, 12-18 Clarendon Street, Artarmon 2064. Phone (02) 9906 6666 or fax (02) 9906 7777.
- Mr Stephen Coop has been appointed by ***Siemens Industrial Automation Department*** as its new manager.
- ***Middle East Electricity 96***, a power generation and electrotechnical exhibition will be held at the Dubai World Trade Centre on 14 to 17 January 1996. For details phone IIR Exhibitions, UK +44 171 344 3812. ❖

5mW Laser Pointer

We look here at an inexpensive kit from Oatley Electronics for a build-it-yourself laser pointer. It has a 5mW laser diode, comes with a neat plastic case and costs $45, making it the cheapest laser pointer we've yet seen.

by PETER PHILLIPS

Looking back through past issues of *EA* gives an interesting history of lasers. Our first laser project was in October 1977, and since then we have presented a range of helium and solid state laser projects, with each successive project being simpler and cheaper than the one before. Many of these projects have come from Oatley Electronics, the supplier of this kit.

The kit we are reviewing here is the cheapest and most compact build-it-yourself laser we have seen. It has a 660nm 5mW laser diode which gives a very bright red beam, even over a long distance.

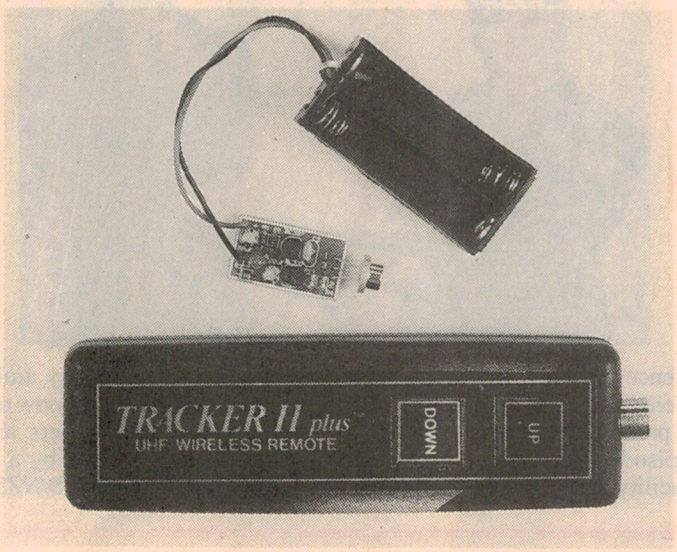
It is powered by two size AAA batteries, and the laser diode is controlled by a current regulator built on a tiny PCB measuring only 15 x 25mm. The laser diode solders to this PCB, so assembly is very simple.

To get such a small PCB, 1/8W resistors and miniature electrolytic capacitors are used. A collimator lens is also supplied in the kit, which not only focuses the laser beam but also provides a heatsink for the laser diode. It's important not to power the laser diode without first fitting the collimator lens, as otherwise the laser diode can burn out.

The regulator circuit is similar to that described in our most recent laser project, a Compact 5mW Solid State Laser, published in *EA* for September 1994. This article gives quite a bit of information about the operation of the regulator. The kit includes the circuit diagram of the regulator and all constructional details.

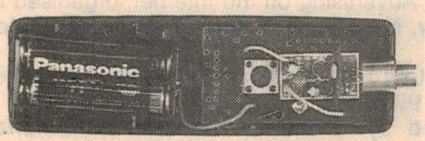
The case

Perhaps the most unusual aspect of this kit is the case. As you can see in the photos, the case supplied in the kit originally housed a UHF remote control transmitter, probably for a control system for a satellite dish. This case measures 39 x 124 x 25mm and is moulded in black plastic. It has two pushbuttons that originally operated switches mounted on the transmitter PCB fitted inside the case. As it turns out, the complete laser assembly fits neatly inside the case, and one of the pushbuttons is used as the on-off switch.



Because the case is flat, it allows the pointer to be used as an alignment aid in building. Being small, the unit can also be put in your pocket, and used as a pointer.

Because it gives such a strong spot, the unit can be used in bright light, and even shows up clearly on an overhead projector image, making it ideal for teachers. It is also useful for presenters to highlight an aspect of a slide show, video, a computer screen or any type of presentation. Many commercial laser pointers use a 1mW laser diode, so you really see the difference with this 5mW pointer.



Here we show the laser pointer with the top part of the case removed. The case is held together with a single screw.

Assembly

Oatley Electronics sent us both a constructed unit and a kit so we could build one for the purposes of this review. The PCB is silk-screened and a layout diagram is supplied in the kit. Perhaps the only difficulty is identifying the value of the resistors, as their small size requires good eyesight to read the colour code. Otherwise construction is easy, and takes about 15 minutes.

The assembly is fitted to the case by mounting the regulator PCB onto the original transmitter PCB. To do this, all transmitter components except the DOWN pushbutton are removed. The battery pack connects to pads on the transmitter PCB, with two links from this board connecting to the regulator PCB. There is also one wire link to add to the copper side of the transmitter PCB. A diagram showing these connections is supplied in the kit.

The regulator PCB is held in place with an insulated wire strap soldered to the transmitter PCB. The only other thing to do is to file an opening in the end of the case for the laser diode. It took us about 20 minutes to complete the assembly, giving a total construction time of 35 minutes or so.

Summary

The most striking aspect of this kit is its price. Commercial laser pointers cost as much as $200 and although smaller, are not as bright.

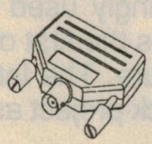
The flat case used in this kit means the pointer can be used as an alignment aid in building, and its strong output makes it useful in sunlight.

For further information contact Oatley Electronics, PO Box 89, Oatley 2223; phone (02) 579 4985. ❖

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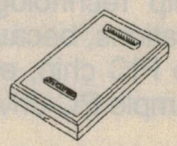
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READER INFO NO. 38

New regulations to reduce the problem of Electromagnetic Interference

From January 1996 the Spectrum Management Agency (SMA) will begin to phase-in an EMC standards framework to control the sources and effects of electromagnetic interference.

The standards will be enforceable from January 1997 and will most directly affect manufacturers, agents of overseas manufacturers and direct importers of electrical and electronic products.

An ***Information for Suppliers*** booklet has been prepared by the SMA to advise of the new arrangements.

To obtain a copy of the booklet suppliers can contact the Spectrum Management Agency on 1800 642 187.

To assist industry in the transition to the new standards a series of programs have been developed by the Department of Industry, Science and Technology. These will be delivered through the Australian Electronics Development Centre.

For information on these programs contact the AEDC on 03 9302 1422.

Electromagnetic Compatibility

Spectrum Management Agency

READER INFO NO. 39

USING THE PIC16C84 SINGLE CHIP MICRO - 1

The Microchip Technologies PIC16C84 microcontroller is being increasingly used for 'dedicated micro' applications, because of its low cost and easy programming. Here is the first of three articles on using the PIC chip, explaining in this case its features and architecture. The later articles will describe a simple PC-driven programmer and also a low cost electronic lock project as a sample application.

by CHARLES MANNING

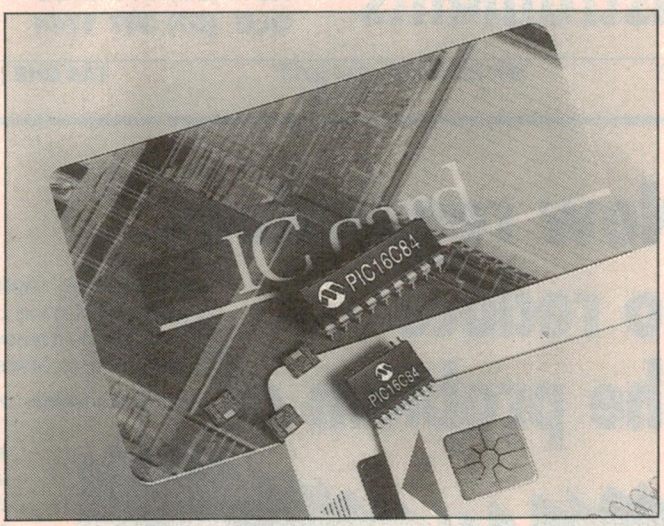
Electronic circuits are often used to monitor and control equipment. This may be as simple as a sequencer for a model railway or sprinkler system, or as complex as a real-time industrial controller. Where once relays and logic gates were used, microcontrollers are now being used to provide more sophisticated and 'intelligent' control.

Unfortunately for the private individual this approach is often not feasible since micro-controller development systems can be very expensive. However these articles will show you how to build your own development system, which has been specially designed to give the amateur highly affordable access to the power of microcontrollers.

A microcontroller is a 'computer on a chip', which has been designed specially for control purposes instead of general purpose computing. As well as the central processing unit, most microcontrollers include random access data memory (RAM), and read only memory (ROM), timers and input/output lines — all in a single chip. Some also include more complex features such as analog to digital converters, serial communications channels and pulse width modulators. As is the case with all electronic technologies, microcontrollers are becoming smaller and many are now available in 'skinny DIP' or surface mount packages with less than 20 pins.

A few years back, the use of miniature microcontrollers was only feasible for large manufacturing companies producing tens of thousands of each product. The design process was slow. Firstly, the design engineers would use expensive design and modelling systems to lay out the design of the device. The designs were sent off to the chip manufacturer, who would take a few weeks (and a few thousand dollars) to make a couple of sample parts for testing.

Hopefully the first design was right, but more likely some bug would be found and this process would have to be repeated. Once the design was tested, the manufacturer would then schedule a production run of these parts.



This slow and costly process kept miniature microcontrollers out of reach, for a growing sector of the market: small engineering firms who could not afford the large costs and long turnaround times. These firms frequently have small budgets and their products are often cost sensitive, have short production runs and need to be delivered quickly.

A few chip manufacturers realised this, and began producing miniature microcontrollers with development systems that the *smaller* companies could afford (a few hundred to a few thousand dollars).

The low cost development system to be described is based on the PIC16C84 microcontroller, from Microchip Technologies, which has some features which make it ideal for the amateur developer. Microchip's PIC series of microcontrollers has created a lot of interest in the electronics development community. Not a day goes by without exchanges about PICs on international news networks like Internet.

Unlike many micro-controllers, which have evolved from general purpose microprocessors, the PIC series were purposefully designed from scratch as small, cheap, feature-packed microcontrollers to suite both small and large scale developers. PICs have a rather novel reduced instruction set (RISC), which makes PIC code very compact and easy to learn. The simplicity of a RISC core allows the PICs to combine low power usage and high performance in small packages. A recent addition to the PIC family is the PIC16C84.

The main difference between the 16C84 and most other microcontrollers is that the program is stored in onboard EEPROM, instead of EPROM. EEPROM memory is erased electrically in a few milliseconds; EPROM typically requires a few minutes exposure to ultra-violet light. Microchip probably did this to allow new programs to be downloaded in the field.

EPROM-based reprogrammable devices are packaged in ceramic, with a quartz window to admit ultra-violet light; however the 16C84 comes in the standard plastic packaging, which makes it cheap when compared with other reprogrammable micro-controllers. As a bonus, EEPROM program

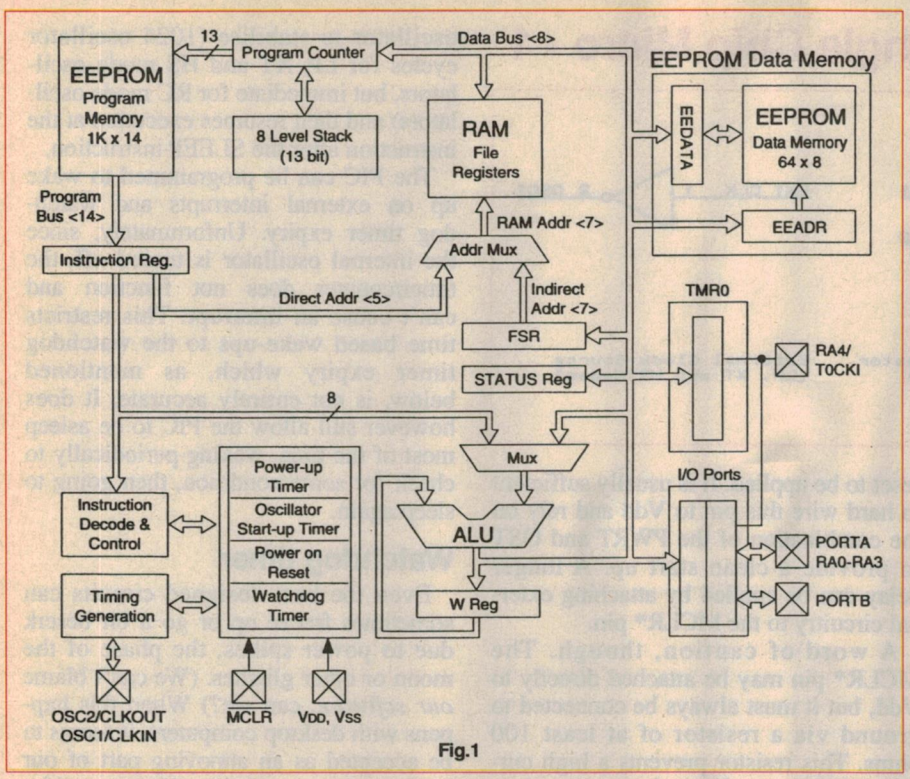


Fig.1

storage also does away with the need for an EPROM eraser.

The PIC16C84 is a CMOS device. This means that it has a really low power consumption, typically 2mA or less at a clock speed of 4MHz and just a few microamps in sleep mode. The 16C84 needs a 4.0 - 6.0V power supply for XT, RC and LP oscillator configurations and a 4.5 - 5.5V supply for the HS configuration.

There is also a low power (or should I say even lower power) version, the PIC16LC84, which can tolerate as low as 2.0V for the XT, RC and LP configurations, but still requires the 4.5 - 5.5V range for the HS configuration.

PIC architecture

The heart of any computing device is its processing core. The PIC has a Harvard architecture, which uses separate memory access paths for program and data. This improves performance, as program memory access can be performed simultaneously with data memory access. Separate memory access also allows the instruction word width to be different from the data memory word width, a trick which the PIC designers have use to great effect in implementing the RISC core. Fig.1 shows the internal block diagram for the PIC16C84.

Unlike most microcontrollers, the PIC has an eight-bit wide data word and a 14-bit wide instruction word (earlier members of the family have 12-bit wide instruction words), allowing all PIC instructions to fit into a single instruction word. This means that the program code is very compact, the instructions execute faster and the design of the core is simplified dramatically. As an example, Microchip quotes 2.24 times the code density and 1.54 times the execution speed of a Motorola 68HC05 for the same oscillator frequency (4MHz), though the PIC16C84 is also available in a 10MHz version.

The 14-bit PIC core supports only 35 instructions and no 'strange' addressing schemes, which simplfies programming. A PIC instruction cycle takes four oscillator cycles. PIC instructions are decoded and executed in one instruction cycle. Fetching an instruction also takes one instruction cycle.

The PIC has a pre-fetch pipeline, which allows an instruction to be executed while the next instruction is being fetched. This allows most instructions to execute in one instruction cycle; the exception being where executing the instruction causes a change in the program counter.

The next instruction in the pipeline cannot be used and an extra machine cycle is required to reload the pipeline. Examples of these include the GOTO and RETURN instructions. Fig.2 shows the clock/instruction timing for the PIC16C84.

The PIC architecture has a program address space of 8192 instructions, which is arranged as four pages of 2048 instructions. Of these, the 16C84 only implements 1024 instruction addresses. This allows Microchip to extend the range of devices in the future and still maintain architectural compatibility. Likewise, only 58 locations of the 512-byte data space are implemented, 36 as RAM and 22 as special function registers.

As a bonus, the 16C84 supports 64 bytes of EEPROM data, which lie outside of the data space and are accessible via special purpose registers. The EEPROM data can be read and modified at run-time and, unlike RAM data, is retained when power is removed from the device.

The PIC devices based on the new 14-bit core support an in-circuit serial programming mode. This is particularly relevant for the 16C84 because the program is kept in EEPROM. New program and EEPROM data can be downloaded without having to disassemble the circuit or the enclosure.

For example, I have designed a 16C84 based circuit which can operate underwater. The 16C84 can be reprogrammed without having to open and reseal the enclosure, and can even be reprogrammed underwater. The serial programming mode means that the programming circuit can be kept very simple.

The PIC core has an eight-deep hardware stack, which is used to store return addresses for subroutine calls and the interrupt service routine. This is a vast improvement on the old PIC family, which only supported a two-deep hardware stack and no interrupts.

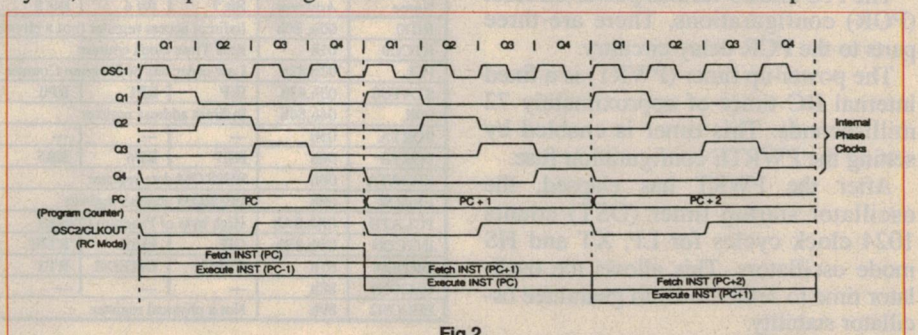


Fig.2

Using the PIC16C84 Single Chip Micro - 1

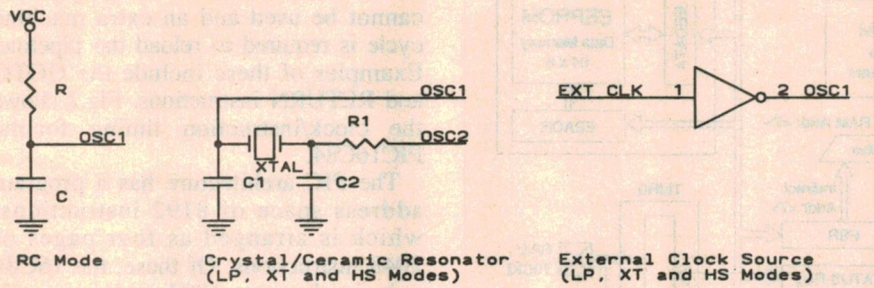


Fig.3

Oscillator modes

The PIC16C84 can support four different clock oscillator modes, which are selected by programming the corresponding configuration fuses. The LP, XT and HS modes cater for various frequency ranges of crystal or ceramic resonator operation, as well as external clock input. Such an oscillator is a must where accurate timing is required. Fig.3 shows the basic oscillator configurations.

The RC mode requires only an external resistor and capacitor. The frequency of oscillation is determined by the resistor and capacitor values and, to a lesser extent, by the supply voltage and temperature. This mode cuts down costs at the expense of reduced accuracy. Microchip suggests that the resistor be kept in the range of 3k to 100k, to ensure oscillator stability and a reasonable degree of accuracy. Similarly, a capacitor value of at least 20pF is suggested. The accuracy of the RC oscillator is typically in the range of +/-20 to 30%, depending on the resistor and capacitor values. Extra error may also be introduced by some capacitor types, which may have tolerance errors of up to 20%. The bottom line is that the RC oscillator configuration should only be used where timing accuracy is not a major consideration.

Power-on reset

The PIC allows various power-on reset (POR) configurations. There are three parts to the POR delay circuitry.

The power-up timer (PWRT) is a fixed internal RC timer of approximately 72 milliseconds. This timer is enabled by setting the PWRTE configuration fuse.

After the PWRT has elapsed, the oscillator startup timer (OST) counts 1024 clock cycles for LP, XT and HS mode oscillators. This allows the oscillator time to settle down to guarantee oscillator stability.

The MCLR* pin allows for an external reset to be applied. It is usually sufficient to hard wire this pin to Vdd and rely on the combination of the PWRT and OST to provide a clean start up. A longer delay can be applied by attaching external circuitry to the MCLR* pin.

A word of caution, though. The MCLR* pin may be attached directly to Vdd, but it must always be connected to ground via a resistor of at least 100 ohms. This resistor prevents a high current latch-up problem from occurring. Thankfully this problem is not shared by other pins on the device.

Power-down mode

The PIC devices support a power-down mode which shuts down the oscillator, 'putting the device to sleep'. The PIC enters the power down mode when the SLEEP instruction is executed. The primary purpose of this mode is to conserve power, though it may also be used as a delay.

The normal power consumption, typically about 2mA, is very low, but this drops to less than 10uA in SLEEP mode — which means that a small battery can keep a PIC in SLEEP mode for a couple of years. This makes the PIC suitable for number of circuits where very low power usage is a major consideration.

Of course there isn't much point in having a PIC just sleeping. The wake-up sequence runs the OST sequence for the oscillator to stabilise (1024 oscillator cycles for LP, XT and HS mode oscillators, but immediate for RC mode oscillators) and then resumes execution at the instruction after the SLEEP instruction.

The PIC can be programmed to wake up on external interrupts and watchdog timer expiry. Unfortunately, since the internal oscillator is turned off, the timer/counter does not function and can't cause an interrupt. This restricts time based wake-ups to the watchdog timer expiry which, as mentioned below, is not entirely accurate. It does however still allow the PIC to be asleep most of the time, waking periodically to check for some condition, then going to sleep again.

Watchdog timer

Even the best designed circuits can sometimes freeze up or go a bit beserk due to power spikes, the phase of the moon or other glitches. (We can't blame *our software*, can we?) When this happens with desktop computers, it seems to be accepted as an annoying part of our high-tech way of life. However if a microcontroller deeply embedded in an appliance goes crazy, you end up with a washing machine stuck on 'spin' or flooding the laundry. A watchdog timer provides a mechanism to help increase the reliability of an embedded microcontroller.

The watchdog timer consists of a timer circuit which is built into the PIC's reset circuitry. This timer must be periodically cleared by executing a CLRWDT instruction. If the timer is allowed to expire, the watchdog 'bites' and resets the PIC.

The timer period is approximately 18 milliseconds. The period is set by an internal resistor and capacitor, so it is prone to minor change with temperature, voltage and manufacturing variations. The period can be lengthened up to approximately 2.3 seconds by using the prescaler available in the OPTION register.

The watchdog timer is enabled by

Name	Address	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
INDO	00h, 80h	Indirect access register (not a physical register)							
RTCC0	01h	Real Time clock counter							
PCL	02h,82h	Low order bits of Program Counter							
STATUS	03h,83h	IRP	RP1	RP0	TO	PD	Z	DC	C
FSR	04h,84h	Indirect address register							
PORTA	05h	---	---	---	RA4	RA3	RA2	RA1	RA0
PORTB	06h	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0
EEDATA	08h	EEPROM data register							
EEADR	09h	EEPROM address register							
PCLATH	0Ah,8Ah	High byte of Program Counter							
INTCON	0Bh,8Bh	GIE	EEIE	RTIE	INTE	RBIE	RTIF	INTF	RBIF
OPTION	81h	RBPU*	INTEDG	RTS	RTE	PSA	PS2	PS1	PS0
EECON1	88h	---	---	---	EEIF	WRERR	WREN	WR	RD
EECON2	89h	Not a physical register							

Fig.5

programming the WDTE fuse in the configuration fuses. As mentioned above, the timer may also be used to wake the PIC from power down mode.

Real time clock/counter

It is very difficult to think of a significant microcontroller application that doesn't require some timing or counting. This has led manufacturers to incorporate hardware counters and timers onboard the micro-controllers. The PIC has a single eight-bit real time clock/counter (RTCC) register, which can be configured to count external events on the RTCC pin (pin 3) or internal clock transitions derived from the oscillator. The source is selected by a bit in the OPTION register.

The RTCC register may be accessed and modified via the RTCC special function register. The RTCC can be configured to generate an interrupt. A timer interrupt is a useful way to execute code at regular intervals.

The RTCC range can be extended by configuring the prescaler to divide the RTCC counting rate by up to 256. This prescaler is configured via the OPTION register, as discussed later.

Interrupts

The idea of an interrupt can be easily explained by an analogy. Consider that you are sitting at your desk performing some task. You have a phone, but it has a tiny indicator lamp instead of a ringer. This means that you need to periodically stop what you are doing and check whether the lamp is lit. If you don't do this often enough, you may miss a call; do it too often and you will never get any of your work done. This is analogous to polling.

Trying to write a program like this is very difficult, since the code must be peppered with regular checks for external events. This situation gets even more difficult if timing is critical.

Now replace the telephone's indicator lamp with the more familiar ringer. You can now get on with your work. When the phone rings, you can stop what you are doing, take the call, then get back to your original task. This is analogous to interrupt handling.

When the microcontroller hardware detects an interrupt condition, it saves the foreground task's current execution context on a stack, then starts executing the interrupt handler code — starting at a special location called the interrupt vector. When the interrupt handler completes its task, it executes a 'return from interrupt' instruction which restores the suspended execution context and the foreground task continues as if nothing had happened. Since the hardware checks for the interrupt events, all the software writer needs to do is specify a single interrupt servicing routine and enable the appropriate interrupts.

Interrupts allow the foreground processing code to be considered separately from the background 'event handling' code. Interrupts really help to reduce the coupling between the foreground task and the background tasks, making the code more robust and easier to understand. A bonus is that this code becomes more modular, which means that it is easier to build reusable software components.

Mnemonic		Description	Flags
ADDLW	k	Add literal to W	C, DC, Z
ADDWF	f,d	Add W to F	C, DC, Z
ANDLW	k	AND literal with W	Z
ANDWF	f,d	AND W with F	Z
BCF	f,b	Clear bit	
BSF	f,b	Set bit	
BTFSC	f,b	Test bit, skip if clear	
BTFSS	f,b	Test bit, skip if set	
CALL	addr	Call address	
CLRF	f	Clear f	Z
CLRW		Clear W	Z
CLRWDT		Clear watchdog timer	TO, PD
COMF	f,d	Complement f	Z
DECF	f,d	Decrement f	Z
DECFSZ	f,d	Decrement f, skip if zero	
GOTO	addr	Goto address	
INCF	f,d	Increment f	Z
INCFSZ	f,d	Increment f, skip if zero	
IORLW	k	OR literal with W	Z
IORWF	f,d	OR W with f	Z
MOVF	f,d	Move f to desination	Z
MOVLW	k	Move literal to W	
MOVWF	f	Move W to f	
NOP		No operation	
OPTION		Load OPTION register	
RETFIE		Return from interrupt	
RETLW	k	Return with literal in W	
RETURN		Return	
RLF	f,d	Rotate f left	C
RRF	f,d	Rotate f right	C
SLEEP		Enter sleep mode	TO, PD
SUBLW	k	Subtract W from k	C, DC, Z
SUBWF	f,d	Substact W from f	C, DC, Z
SWAPF	f,d	Swap nibbles	
TRIS	f	Load tristate register	
XORLW	k	XOR literal with W	Z
XORWF	f,d	XOR W with f	Z

Fig.4

Instruction set

As mentioned before, the PIC instruction set is very simple and can be mastered in a short time. However, it may not seem too familiar to those experienced with some other microcontroller instruction sets. This is due, in part, to the RISC architecture and the awkward mnemonics. Fig.4 shows the complete PIC16C84 contruction set.

The PIC has only one working register, the W register. This is used primarily for arithmetic operations. It is also often used as a dummy register where the results of an operation are to be discarded. The PIC's data memory is called 'file registers' which often causes some confusion.

It is useful to identify the various operand types, to understand how the instructions work.

The first type are the byte-oriented operations on file registers. These typically have two operands, referred to as **f** and **d**. The **f** operand is a seven-bit address which selects which file register is being manipulated. The **d** operand is a single bit which selects the destination of the result; 0 selects the W register and 1 selects the file register specified in **f**.

Note that the two clear instructions, CLRF and CLRW, really fall into this category although they do not have two operands. CLRF, the clear file instruction, requires only the **f** operand and the destination is implicitely the file register; CLRW, the clear W instruction, is effectively a CLRF instruction with the destination set to W.

The second type is the bit-oriented file register operations. These operations have two operands, **f** and **b**, a seven- bit file register address and three-bit bit address respectively. These allow any bit in the file registers to be set, cleared or tested.

The third type of operand require a single literal byte operand. The mnemonics for all of these operations end in LW, indicating a literal value operation on the W register.

Using the PIC16C84 Single Chip Micro - 1

The last operand type is the 11-bit program address used by the GOTO and CALL operations.

Conditional execution

Unconditional branching is supported by the GOTO and CALL instructions. Conditional execution is supported by four instructions, DECFSZ, INCFSZ, BTFSC and BTFSS, all with similar semantics. All these instructions skip the execution of the next instruction if a certain test condition is met. For example:

```
.....
DECFSZ test,w
MOVLW 5
.....
```

Here the first DECFSZ instruction is the decrement test, decrementing the **f** register and putting the result in W. The second MOVLW 5 instruction is skipped if the result of this decrementing was zero.

Conditional branching thus requires two instructions; one of these instructions, followed by an unconditional branching instruction such as GOTO. Although this may seem unwieldy at first, it can be used to generate fast and compact code sequences.

Special instructions

Apart from the addressing and conditional execution semantics, most of the instruction set will seem reasonably familiar to the average assembler 'hacker'. The PIC does however support some special instructions which manipulate special PIC features. These are the CLRWDT, SLEEP, OPTION and TRIS instructions, which are explained elsewhere.

Part of the reason why the PIC RISC core can be kept so simple is the rich set of special function registers (SFRs). The PIC16C84 supports 16 SFRs, which are used to access special features. All of the SFRs are mapped in to the PIC data space, and are accessed as if they were normal RAM data locations. The SFRs are listed in Fig.5, and are described below.

IND0 and FSR: This pair allow data memory to be indirectly accessed. The address of the data memory to be accessed is placed in the FSR. The specified data memory can then be accessed as if it were in the IND0 register. The following code fragment may explain this better.

```
MOVLW 10    ; put value '10'
              into FSR
MOVWF FSR   ;
MOVF IND0,W ;accessing IND0
              actually accesses
            ;data at address '10'
```

Indirect memory access is often useful for iterative operations such as reading or writing to buffers.

RTCC: The RTCC SFR gives access to the RTCC register mentioned above. This register may be read or modified.

PCL and PCLATH: These registers allow access to the low and high bytes of the current program counter (PC). The program counter holds the address of the instruction which is currently being executed. Accessing the PC is not done commonly, except as a way to perform table look-ups or implement state machines.

Note that modifying the program counter invalidates the instruction pipeline. This means that an extra instruction cycle is required to load the next instruction.

PS2	PS1	PS0	PSA=0 RTCC	PSA=1 WDT
0	0	0	1:2	1:1
0	0	1	1:4	1:2
0	1	0	1:8	1:4
0	1	1	1:16	1:8
1	0	0	1:32	1:16
1	0	1	1:64	1:32
1	1	0	1:128	1:64
1	1	1	1:256	1:128

Fig.6

STATUS: The status register holds the current arithmetic status, reset status and page preselector bits.

C is the carry/borrow* bit. This bit is set if a carry out or borrow out occurred in the last arithmetic instruction (ADDWF, ADDLW, SUBWF, SUBLW). This bit is also modified by the rotate instructions (RLF and RRF).

DC is the digit carry/borrow* bit. Its semantics are identical to **C** for arithmetic operations, except that it reflects a carry out or borrow out from bit 4 of the W register. This bit is not affected by rotate operations.

Z is the zero bit. This bit is set if the result of an arithmetic, logical or MOVF instruction is zero.

PD is the power-down bit. This is set to 1 during power-up or by a CLRWDT command. It is set to 0 by a SLEEP command.

TO is the time out bit. This is set to 1 during power up and by the CRLWDT and SLEEP commands. This bit is set to zero by a watchdog timeout.

The PD and TO bits may be used in conjunction to determine the cause of the last reset.

The PIC architecture supports 512 bytes of data space. This can be accessed directly with a seven-bit address embedded in the instruction, or indirectly by specifying an eight-bit address in the FSR register. Since nine bits are required to address the 512 byte data space, an extra two bits are required for direct addressing and an extra single bit is required for indirect addressing. These extra bits are known as the page select bits.

RP1 and **RP0** are the register page select bits for direct addressing of data space. **IRP** is the register page select for indirect addressing of data space.

The PIC16C84 only supports the first 256 locations of the data space. This means that RP1 and IRP have no effect on addressing for this device. These bits may be used for general purpose storage, but doing so would mean that the code could not be transferred to future devices which support the entire address space.

OPTION: The option register controls some of the special functions available on the PIC devices. The OPTION instruction may be used to load this register from the W register. By default all the bits are 1.

PS2, PS1 and PS0 are the prescaler rate bits. These control the prescaler division rate. PSA is the prescaler assignment bit. This assigns the prescaler to the real time clock/counter (RTCC) if zero and to the watchdog timer if set to 1. Fig.6 shows the prescaler values for different values of these bits, while Fig.7 shows the actual pin connections for the PIC16C84.

RTE controls the RTCC signal edge. The RTCC will increment on a low to high transition if this bit is zero, otherwise the RTCC will increment on a high to low transition. This is only useful if the RTS bit is set.

RTS selects the RTCC signal source. The RTCC will increment on internal clock transitions if this bit is zero, otherwise the RTCC will increment on transitions of the RTCC pin.

INTEDG selects interrupt edge sensitivity of the INT pin (pin 6). The interrupt will occur on falling edges (high to low transitions) if this bit is zero, otherwise the interrupts will occur on rising edges (low to high transitions).

RBPU* enables the weak pull-ups on port B when this bit is set to zero, otherwise the pull-ups are disabled. The pull-ups are disabled by default.

INTCON: This register controls which interrupts are enabled and identifies which interrupts have occurred. The interrupt mechanism is very flexible, to allow it to be tuned to react only to specific events.

RBIF is the port B interrupt flag. This is set when any of the Port B 4,5,6 or 7 input pins change. This flag must be reset in software.

INTF is the INT pin interrupt flag. This is set when the INT interrupt occurs. This flag must be reset in software.

RTIF is the RTCC overflow interrupt flag. This is set when the RTCC overflows. This flag must be reset in software.

The RBIE, INTE, RTIE and EEIE bits control whether the corresponding RBIF, INTF, RTIF and EEIF flags should cause interrupts. A zero value disables the corresponding interrupt, otherwise the corresponding interrupt is enabled. Note that the EEIF flag is in the EECON1 register.

GIE is the global interrupt enable flag. If this flag is zero then no interrupts are enabled, otherwise the interrupts specified.

PORTA, PORTB, TRISA and TRISB: These four SFRs control access to the 16C84's thirteen I/O pins. PORTA gives access to the pins labeled RA0 to RA4 and, quite predictably, PORTB gives access to the pins labeled RB0 to RB7. All of these pins can be used as both outputs and inputs. The TRISA and TRISB registers control whether the pins in the corresponding PORTA and PORTB registers should be used as inputs or outputs. The TRISx registers may be set just like any other register, or the special TRIS instruction may be used.

Although all of these port pins can be used for both input and output, they are not equal. Four of the port A pins, RA0 to RA3, are standard I/O pins which accept TTL input levels. They have push-pull output drivers.

The fifth port A pin, RA4, has a Schmitt trigger input which gives a better noise immunity than the standard TTL level inputs. This pin may also be used as an input source for the RTCC counter. This pin can be used as an open-collector output, which is a useful feature for many situations.

The port B pins are standard I/O pins which accept TTL input levels. Four of these pins, RB0 to RB3, have 'weak' pull-ups (typically 100uA). The weak pull-up is only active while the pin is in input mode and only if enabled by the RBPU* bit in the OPTION register. Port B has five special purpose pins. RB0 may also be used as the INT interrupt pin. RB4 to RB7 support an interrupt-on-change capability for all the pins configured as input pins.

A word of caution is in order here. The actual write to an I/O pin only happens at the end of an instruction cycle, but the input state is latched at the beginning of a read operation. If a read instruction follows a write instruction, it is suggested that at least one instruction be inserted between the write and read, to allow the pin voltage to stabilise for the read operation.

EEDATA, EEADR, EECON1 and EECON2: These four registers control access to the 64 bytes of EEPROM data on the 16C84. EEDATA and EEADR work in a similar fashion to the IND0 and FSR pair. The address of the byte to be accessed is written into the EEADR register; the data at that address can then be accessed via the EEDATA register. This is relatively straightforward for reading the data, but writing the EEDATA is a bit more complex.

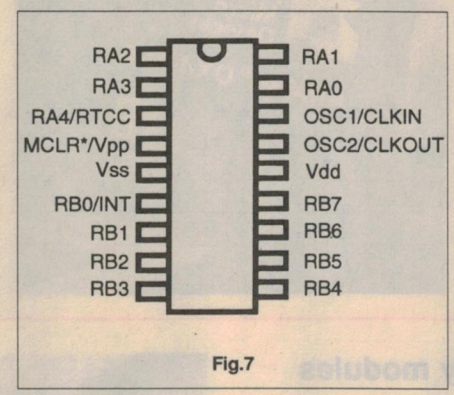


Fig.7

An EEPROM write cycle is a lengthy affair, taking up to 10 milliseconds. The WR bit in the EECON1 register is cleared by the EEPROM programming logic when the write cycle completes. The programming logic may also be configured to generate an interrupt on completion of the write cycle.

The EECON1 register is used to access the EEPROM control logic. It has the following five bits.

RD is the read control bit. Setting RD to 1 initiates an EEPROM read. This bit is cleared after a read by hardware and can not be cleared in software. A read takes one clock cycle.

WR is the write control bit. The EEPROM write cycle is initiated by performing a fixed sequence of accessing EECON2 then setting WR to 1. WR is cleared by hardware when the write cycle has completed and, like the RD bit, cannot be cleared in software. As mentioned above, the write operation takes about 10 milliseconds.

WREN is the EEPROM write enable bit. All writes to EEPROM are inhibited when this bit is zero, otherwise they are allowed.

WRERR is the write error flag. This bit is set if a reset occurs and prevents the write operation from completing.

EEIF is the EEPROM write completion interrupt flag. This is set when a write cycle completes. This will generate an interrupt if enabled by the EEIE bit in the INTCON register.

EECON2 is not a physical register and is only used for performing part of the write sequence.

Configuration word

The configuration word controls the PIC's hardware features and is not a register or part of the program instruction space. It is not accessible at runtime, but can be accessed by the programmer. The following functions are supported.

FOSC1 and FOSC0 are used to select the oscillator type. By default, the RC oscillator is configured.

WDTE enables the watchdog timer feature. This is the only way to control the watchdog timer. In particular, the watchdog timer cannot be disabled by software. The watchdog timer is enabled by default.

PWRTE is the power-up timer enable fuse. This controls the operation of the power-up reset circuitry. This is enabled by default.

CP is the code protection fuse. Note that the logic of this fuse is the inverse from the other bits; code protection is enabled when this bit is zero.

If code protection is enabled, reading the PIC will not produce any meaningful output and the program cannot be overwritten. This prevents unauthorised duplication of the program.

This fuse also serves two extra purposes in the 16C84. Firstly, it also prevents the EEPROM data from being accessed from the programmer. Secondly, it provides a mechanism for erasing the EEPROM data and program. Whenever the CP fuse is altered from 0 to 1, the entire EEPROM is erased.

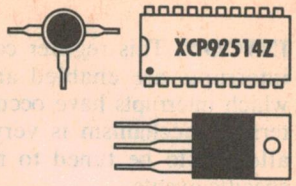
Conclusion

This concludes the description of the PIC16C84. This is by no means a full explanation of every detail and feature of the device, but it hopefully gives a good idea of what features are packed into these remarkable devices.

In the second of these articles I will show you how to build a simple and inexpensive PC-based development system for this microcontroller.

(To be continued.) ❖

Solid State Update



KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

Efficient voltage regulator ICs

The new ZR78L05 voltage regulator IC from Zetex features a quiescent current of 350uA, claimed to be less than 20% that of other 78L equivalents. As well, its line and load regulation characteristics are specified for a load current of 200mA, compared to 100mA for other similar devices.

The regulator is claimed to be completely stable without needing any external components, and to be impossible to destroy due to its current limit and thermal shutdown functions.

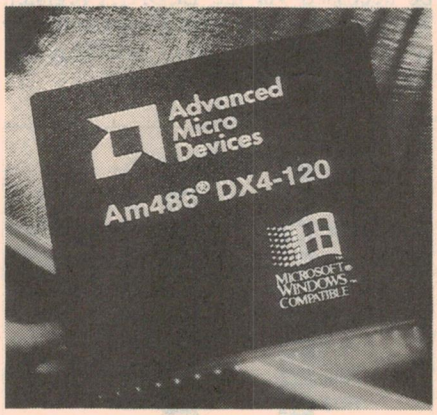
It is packaged in both low profile though hole TO92 and surface mount SOT223 packages and is specified across the temperature range of -55 ° to 125°C. Other regulators in the range have the same features and cover the voltage range of 2.85 to 10V.

For further information circle 280 on the reader service coupon or contact GEC Electronics Division, 38 South Street, Rydalmere 2116; phone (02) 638 1888.

120MHz '486

Advanced Micro Devices has released a 120MHz version of its Am486 microprocessor family. The new processor is claimed to offer the same performance as a 75MHz Pentium processor.

The Am486 family of microprocessors feature writeback cache memory and a two-pin industry standard system management mode (SMM). They also have a 'stop clock/auto halt' feature that allows all CPU activity to be halted, reducing power by more than three watts and making them suitable for portable computers.



The writeback cache memory is claimed to boost the performance of portable systems, and to maintain high performance in entry level desktop PCs, while reducing the cost by eliminating the need for SRAM cache memory. The family is supported by a broad range of chipset and BIOS suppliers, and is Windows 95 compatible.

For further information circle 288 on the reader service coupon or contact VSI Electronics, Unit C, 6-8 Lyon Park Road, North Ryde 2113; (02) 878 1299.

ATM design kit

Altera Corporation has released what it claims as the programmable logic industry's first ATM (synchronous transfer mode) design kit. This design kit provides ATM designers with technical information for designing ATM equipment with Altera's FLEX 8000 programmable logic devices (PLDs).

"ATM is the networking technology that will take us into the next century. While the standards are still evolving,

Eight megabit Flash memory modules

White Electronics has announced the introduction of its high performance WF128K64 CMOS family of compact Flash PROM memory modules. These eight megabit memory modules are designed to interface to the new 64-bit processors, and are believed to be the industry's first quad flat pack flash memory MCM for 64-bit microprocessors.

Designed for surface mounting, the 116-pin devices are housed in a hermetic ceramic package, measuring 40mm square and 5.1mm high.

The modules feature low power CMOS design, TTL compatible inputs and outputs and are suited for use as high density memory for flight recorders, data accumulation and code storage. The modules are guaranteed for a minimum of 10,000 erase/program cycles at 125°C (100,000 at 25°C) and a minimum data retention period of 10 years (at 125°C). They offer access times of 150 and 200ns. Programming voltage is 12V, while supply voltage is 5V. Typical standby current is 4mA. Organised as 128Kx64, these 8-megabit modules are user configurable as 1Mx8, 512Kx16, or 256Kx32.

For further information, contact White Micro-electronics, 4246 E. Wood Street, Phoenix, AZ 85040; phone (602) 437 1520.



the road to the market place for ATM equipment manufacturers is risky," said Cliff Tong, Altera's director of product marketing.

"Programmable logic offers unmatched adaptability, ease of use, and performance necessary to meet the needs of the ATM designer while minimising the company's exposure to risk."

The designer kit provides system building blocks to use as the foundation for complex ATM designs. One building block details the implementation of a high speed 16-bit parallel cyclic redundancy checker (CRC), a common error checker in high speed networking applications such as ATM.

Implemented in the FLEX architecture, a 16-bit CCITT CRC design operates at over 80MHz. A designer can customise a CRC of larger of smaller word size in minutes by modifying the CRC macrofunction. Another application explores traffic control, a topic currently being examined by the ATM Forum. To support a wide variety of ATM traffic, parameters such as bandwidth, delay, and jitter need to be guaranteed.

As a result, designers are required to use the appropriate traffic scheduling algorithms for proper resource allocation in ATM switches. Altera's ATM design kit provides a sample ATM packet scheduler design, based on a weighted round robin scheduling algorithm that schedules input from multiple ports to one output port.

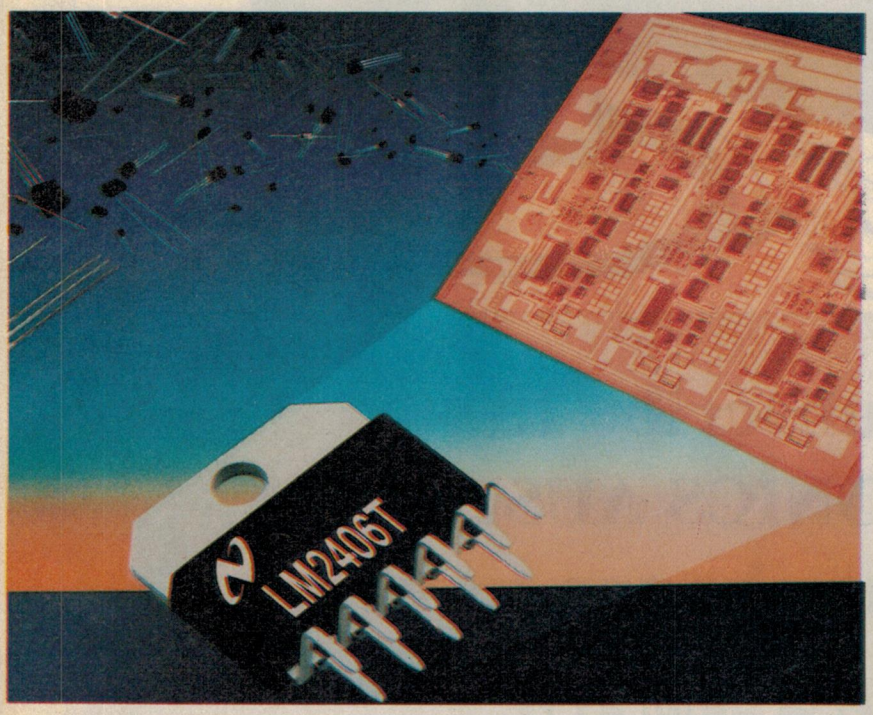
For further information circle 272 on the reader service coupon or contact Veltek Australia, 18 Harker Street, Burwood 3125; phone (02) 808 7511.

First monolithic CRT driver

National Semiconductor has introduced what is claimed to be the industry's first monolithic CRT driver. The new LM2406T triple channel, 40MHz CRT driver, developed as a key technology for shaping information, is designed for SVGA and XGA monitor applications. The device is capable of supporting scan frequencies up to 58kHz/72Hz. When used with National's LM1203N or LM1207N video amplifiers, the LM2406T provides a complete video channel solution for SVGA and XGA monitor applications.

The device can drive a cathode capacitance of 8pF with a voltage swing of 40Vp-p and has a rise and fall time of 9ns, making it ideal for colour SVGA and XGA monitors. Its monolithic design incorporates internal protection to prevent momentary short circuiting. The LM2406T operates from an 80V and 12V power supply, and is available in a reduced size TO-220 package. This package allows a smaller enclosure, thus minimising EMI emissions.

For further information circle 275 on the reader service coupon or contact National Semiconductor, Business Park Drive, Monash Business Park, Notting Hill 3168; phone (03) 558 9999.



Surface mount 900MHz transistor

Hewlett-Packard has introduced its lowest cost, 900MHz silicon bipolar transistor, the AT-415 series, in a SOT-23 surface mount package. The three lead SOT-23 package is widely used in compact circuit layouts.

The repackaged transistor type AT41533, is designed for applications such as cellular phones, wireless local area networks, and direct broadcast satellite receivers. It is suited for low noise amplifiers, gain stages, buffers, oscillators, active mixers and other high frequency applications.

The device features a 1dB noise figure at 900MHz and power output at 1dB gain compression of +14.5dBm (at 5V, 25mA), and is characterised for operation at 2.7, five, and eight volts. The SOT-23 package is compatible with high volume automated assembly techniques.

For further information circle 271 on the reader service coupon or contact VSI Electronics, Unit C, 6-8 Lyon Park Road, North Ryde 2113; phone (02) 878 1299. ❖

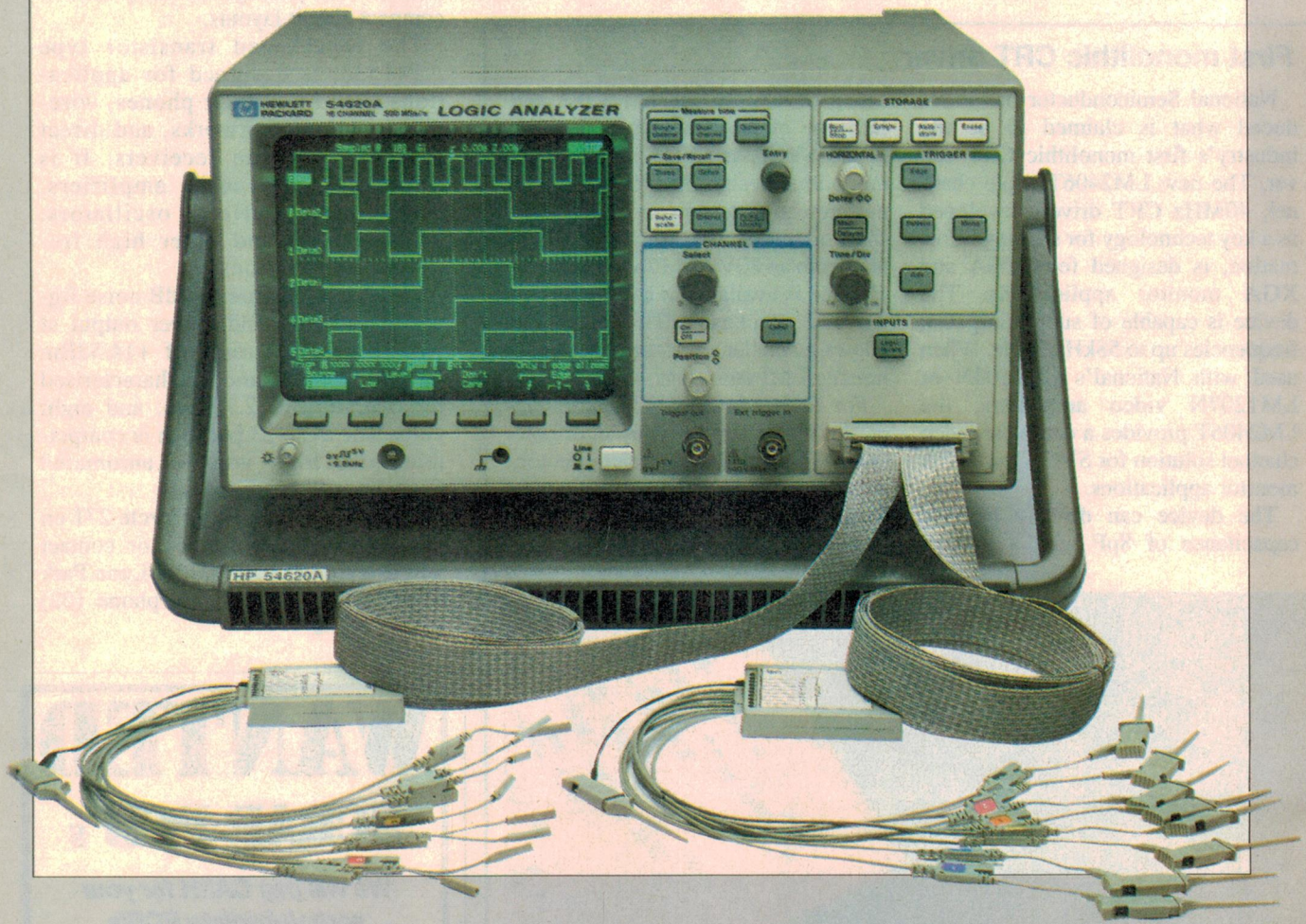
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For further information on the HP 54620A, call the Hewlett-Packard Customer Information Centre on 13 1347 (Australia Wide) and ask for extension 2902.

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CONDITIONS OF ENTRY: 1. The competition is open to Australian residents authorising a new or renewed subscription to Electronics Australia before last mail on 23.01.96. Entries received after closing date will not be included. Employees of the Hannan Group, Hewlett Packard, their subsidiaries and families are not eligible to enter. 2. South Australian residents need not purchase a subscription to enter, but may enter once by submitting their name, address and phone number to: Electronics Australia/ Hewlett Packard Competition, PO Box 199, Alexandria, NSW, 2015. 3. Prizes are not transferable or exchangeable and may not be converted to cash. 4. The judge's decision is final and no correspondence will be entered into. 5. Description of the competition and instructions on how to enter form a part of the competition. 6. The competition commences 20.09.95 and closes last mail on 23.01.96. 7. The draw will take place in Sydney on 02.02.96 at 11am and the winners will be announced in a later issue of Electronics Australia and notified by mail. 8. The prize is: 2 X Hewlett Packard HP 54620A Logic Analysers, valued at $5557 each. Total prize value is $11,114. 9. Subscriptions are not refundable. 10. The promoter is the Federal Publishing Company Pty. Ltd., 180 Bourke Rd, Alexandria NSW 2015. Permit No. TC95/4138 issued under the Lotteries and Art Union Act 1901; Vic. Permit No. 95/1393 issued on 09/08/95; ACT permit no. TP95/1668 issued under the Lotteries Act 1964; NT permit no. 95/1484.

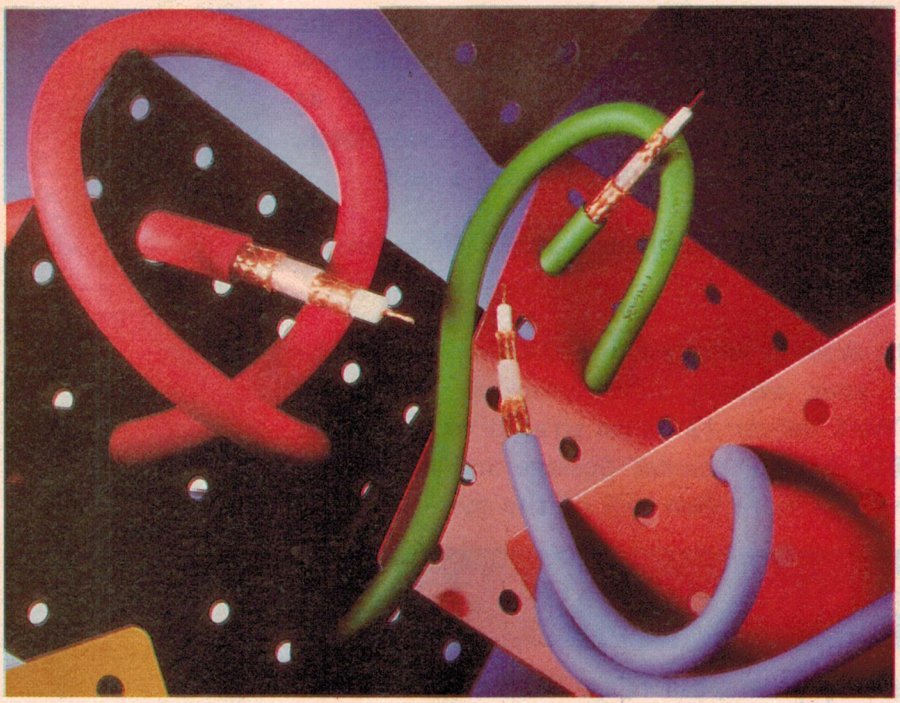
ELT/LOG/000

NEW PRODUCTS

Flexible triaxial cables

Belden has announced three new high flex video triaxial cables. Used to interconnect video cameras to their equipment, these highly flexible cables can simultaneously carry a number of different signals.

The new cables contain two isolated shields and a centre conductor. The outer shield is used as a signal ground while the centre conductor and inner shield are used to carry the video signal and other transmissions. Examples include supplying DC power to the camera, intercom-to-operator signals, teleprompter feeds, monitoring feeds, and automatic or robotic functions.



The cables are available in either a solid or stranded conductor. The High Flex 20 AWG solid centre conductor cable, an RG-59/U type, is easy to terminate and uses Belden's patented, high resilient Belflex jacket to provide good flexibility.

The Super-Flex triaxial cables use a 19 strand design with 0.2mm^2 or 0.1mm^2 strands. The resulting 22 AWG 0.325 mm^2 (RG59/U type) and 15 AWG 1.65 mm^2 (RG11/U type) centre conductors provide high flexibility. Each triaxial cable is 100% sweep tested to ensure the highest signal integrity.

For further information circle 251 on the reader service coupon or contact Belden International, PO Box 316, South Yarra 3141; phone (03) 9826 0448.

Colour analyser for monitors

The Philips PM5639 Colour Analyser comprises a colour sensor, which is attached by a suction cap to the screen of the CRT, and a hand held analyser to provide a simple means of controlling and adjusting the colour balance and brightness of any colour monitor. It uses

RF antenna testing

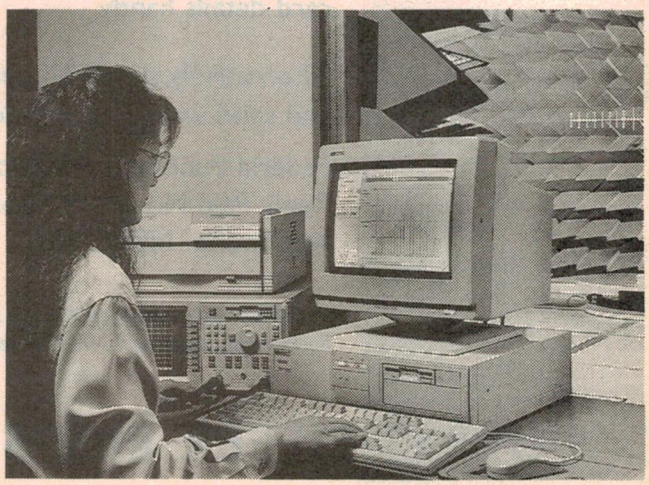
Hewlett-Packard has released an integrated, fully automated, low cost RF antenna test system, claimed to be an industry first.

With automation, essential antenna pattern comparisons can be performed in about half the time it takes with a manual system. Pattern plots generated by the test system illustrate the quality of a finished product and allow antenna manufacturers, in turn, to demonstrate expected product performance, quality and reliability to their customers.

The HP 85375 antenna test system measures, plots and analyses antenna performance. It also performs pattern comparisons, which are an essential element of the antenna design process.

The Windows based software is claimed to be easy to learn and use. In addition, the network analyser that is part of the system can be used independently to measure antenna impedance or make measurements on RF components.

For further information contact Hewlett-Packard's Customer Information Centre on 131347, extension 2902 (Australia wide).

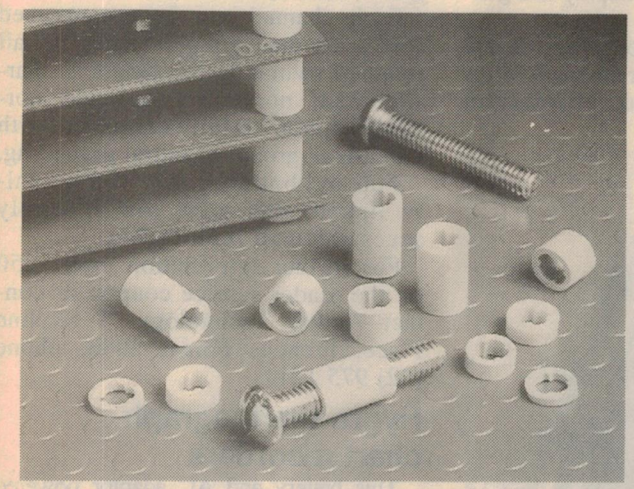


Spacers for stacking PCBs

A new series of self retaining screw spacers from Bivar minimise handling when PCB stacks are being assembled, or with any other assembly where spacing must be even and rigid. Each spacer is designed with a ribbed inner wall which insures a snug fit onto screws and enables the spacers to remain pre-assembled during handling and assembly.

The spacers are manufactured in rigid PVC material for strength with a 94V-0 UL rating, and come in five standard sizes in lengths from 0.76 to 31.8mm in 0.127mm increments for #4, #6, #8, standard screws or M3 and M4 metric screws.

For further information circle 244 on the reader service coupon or contact M. Rutty & Co., 1/38 Leighton Place, Hornsby 2077; phone (02) 476 4066.



an adaptive system to establish the correct measurement independent of the field rate, and works with all field rates including HDTV systems, progressive and interlaced systems.

The analyser operates with all types of phosphors using a filtering technique which parallels the response of the human eye. It has a 64 x 128 dot matrix LCD display with a back light for use in dim lighting conditions.

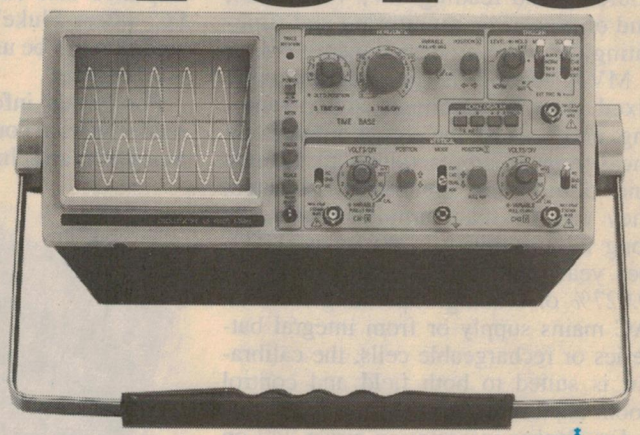
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ted on a CIE 1931 chromaticity diagram, and the X and Y values, the luminance and the colour error (CIELUV) are shown on a numerical display either in candela/m² or foot lamberts.

For further information circle 241 on the reader service coupon or contact Tech Rentals, PO Box 621, Ringwood 3134; phone (03) 9879 2266.

Portable calibrator

The Druck model MVX is a highly compact, portable calibrator capable of sourcing and reading mV, V and mA, and of powering, monitoring and simulating two wire process transmitters.

MVX testing is in programmable fixed steps or automatic signal ramping, and because the signal outputs and measurement inputs (at up to 120mV and 52mA) are electrically isolated, they can be read simultaneously. Its long term stability is stated as 0.02% per year, and it is accurate to within 0.027% of reading. Operating from an AC mains supply or from integral batteries or rechargeable cells, the calibrator is suited to both field and control room environments.

For further information circle 242 on the reader service coupon or contact M.B. & K.J. Davidson, 17 Roberna Street, Moorabbin 3189; phone (03) 555 7277.

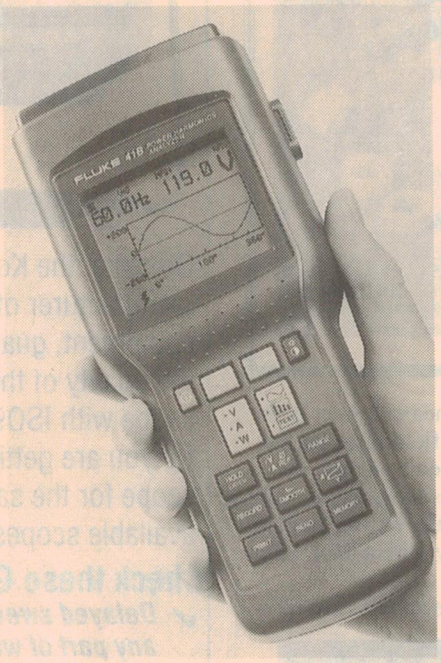
Handheld power harmonics analyser

The newly released Fluke 41B is the successor to Fluke's 41 Power Harmonics analyser. The new handheld instrument features a three-phase readout derived automatically from a single-phase measurement, eliminating the need for manual calculations or complex power quality analysers. Other features include enhanced memory operation and an improved record mode for data capture.

The instrument can measure voltage, current, frequency or power. Voltage and current readings are in true RMS. Measured signals can be viewed in three ways: a waveform, a bar graph showing the level of harmonics, or a numeric value.

The bar graph display has a high-definition zoom function that makes small harmonic content visible. Captured data can be downloaded to a PC, where FlukeView 41 documenting software can be used to display and generate reports.

For further information circle on the reader service coupon or contact Philips Scientific and Industrial, 34 Waterloo Road, North Ryde 2113; phone (02) 888 8222.



Audio patch panel

Neutrik's new Easy Patch audio signal patch panels are pre-assembled on printed circuit boards terminated with spring loaded punch blocks, for rapid connection without soldering. They are housed in a rugged IU standard rack mounting enclosed with an integral cable strain relief. The panels are available with 96 bantam (TT) jacks or 48B-gauge (phone) jacks, both featuring high quality gold plated Neutrik jack assemblies.

Each channel can be programmed with individual jumper blocks for all standard switching combinations: parallel, half normalled top, half normalled bottom or fully normalled, with individual, group or central grounding.

Top and bottom rows are internally linked, and each row is easily accessible and replaceable.

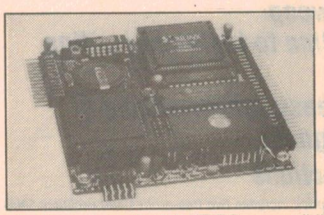
For further information circle 250 on the reader service coupon or contact Amber Technology, 5 Skyline Place, Frenchs Forest 2086; phone (02) 975 1211.

Hygro-thermograph chart recorders

This battery and AC adaptor powered recorder with high polymer (electro-resistance) humidity and semiconductor temperature sensors is ideal for temperature/humidity recording in industries such as pharmaceuticals, food processing, chemicals, printing as well as in museums, laboratories and medical care centres.

The ST-100V recorder weighs 3kg and is constructed with an attractive acrylic splash and dust proof cover. Ink free dot-pressure sensitive recording

Australian Computers & Peripherals from JED... Call for data sheets.

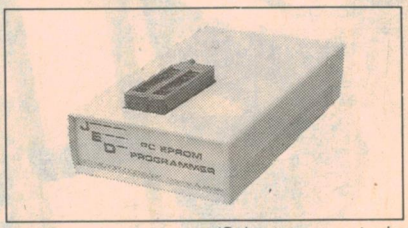


Australia's own PC/104 computers.

The photo to the left shows the JED PC540 single board computer for embedded scientific and industrial applications. This 3.6" by 3.8" board uses Intel's 80C188EB processor. A second board, the PC541 has a V51 processor for full XT PC compatibility, with F/Disk, IDE & LPT. Each board has two serial ports (one RS485), a Xilinx gate array with lots of digital I/O, RTC, EEPROM. Program them with the $179 Pacific C. Both support ROMDOS in FLASH. **They cost $350 to $450 each.**

$125 PROM Eraser, complete with timer

$300 PC PROM Programmer.



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This little box simply plugs into your PC or Laptop's parallel printer port and reads, writes and edits PROMs from 64Kb to 8Mb. It does it quickly without needing any plug in cards.

JED Microprocessors Pty. Ltd

Office 7, 5/7 Chandler Road, Boronia, Vic., 3155. Phone: (03)9 762 3588 Fax: (03)9 762 5499

READER INFO NO. 42

provides permanent and continuous records for one, three or six month periods. The recording period is selectable by means of a three speed, crystal oscillator controlled chart drive. The built in LCD simultaneously displays temperature and humidity.

For further information circle 246 on the reader service coupon or contact Nilsen Technologies, 150 Oxford Street, Collingwood 3066; phone (03) 9419 9999.

Non-contact temperature probes

The Fluke 80T-IR and 80PK-IR are non-contact temperature probes designed for measurement tasks where physical contact is difficult or hazardous. Applications include measuring the operating temperature of motors and bearings, pinpointing electrical hot spots (including high resistance joints), testing circuit board components, monitoring the temperature of substances without risk of contamination and measuring the temperature of moving or difficult to reach objects.

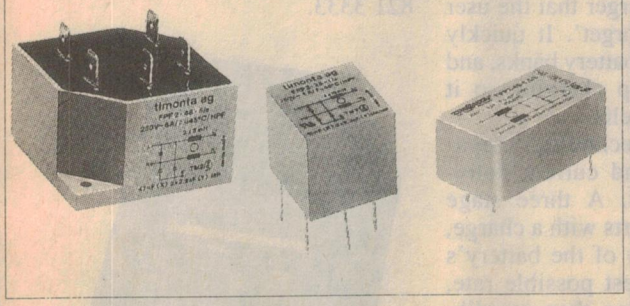
The probes work by sensing the infrared energy emitted by an object and converting it to a temperature reading. Both units give correct readings for nearly all non-reflective objects. Reflective objects can be treated with non-reflective paint or tape to obtain correct readings.

The range for both probes is -18° or +260°C with an accuracy of +/-3% or 3°C, whichever is the greater. The optical resolution of the probes is set to a ratio of 4:1, so for example, with an object 14mm in diameter the probe can be up to 50mm away for a reliable and repeatable reading.

For further information circle 255 on the reader service coupon or contact Obiat, PO Box 37, Beaconsfield 2014; phone (02) 698 4111. ❖

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- Approvals

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READER INFO NO. 54

High Power AC & DC Supplies



Behlman's BL Series AC supplies take up just 90mm of rack space yet provide 1350VA of quality AC power. Frequency is fully adjustable 45 to 500Hz and voltage 0 to 270V with THD of only 0.5%. Efficiency is typically 80%. Other models, including solid-state frequency converters, up to 120kVA 3ø are available.



The EMS Series from Electronic Measurements Inc is a constant current/constant voltage programmable switch-mode DC supply with ratings up to 5kW.

Other supplies are available from 60W up to 90kW with DC outputs from 7V to 600V. They include specialised supplies for capacitor charging and laser applications.

Whatever your AC or DC power supply need contact us for data or application advice.

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READER INFO NO. 43

Special Feature:

Power Supply Products

Programmable bench supplies

Kepco's MBT and MBT-G series are 360 watt bench style programmable instrumentation power supplies that offer a choice of control methods. Full talk-listen functions are provided via an IEEE 1118 serial bus. The MBT-G models offer IEEE 488-2 and RS-232C bus communications as well. With 16 base models in all, these units provide voltage outputs ranging from 0 - 6V DC to 0 - 150V DC with currents from 32 amps down to 2.4 amps, depending on the model.

A 24-key front panel control is the primary control input and also enables a variety of functions including GPIB address, store and status. Conventional knobs provide a familiar feel for adjusting voltage and current values, and drive optical encoders connected to the control system.

A two line, 32 character liquid crystal display prompts for input entry, displays messages and reads back values.

The DC output on all models is a low noise linear series regulator type featuring crowbar over-voltage protection and over-current protection via a circuit breaker. Output enable and output polarity reversal relays are available as a factory fitted option.

For further information circle 202 on the reader service coupon or contact Obiat, PO Box 37, Beaconsfield 2014; phone (02) 698 4111.

Low Cost switching supplies

Computronics has been appointed distributor and stockist for the Mean Well Enterprises range of switch-mode power supplies.

Mean Well switch-modes are rated from 150W to 300W with single, double, triple or quad output configurations. The designs feature high efficiency with low output ripple.

The supplies have short circuit, overload and over-voltage protection and inbuilt EMI filtering. With ISO 9001 certification, Mean Well quality control procedure includes 100% burn-in testing to give a high MTBF rate.

For further information circle 203 on the reader service coupon or contact Computronics International, 31 Kensington Street, East Perth 6004; phone (09) 221 2121.

Power supplies for DIN tracks

Omron have released the S82K series, which is a popular, compact direct DIN-track mounting general purpose power supply with 15, 30, 50 and 100W models available. The S82S is the thin, low capacity model with a depth of 65mm and a wide AC/DC input range which is ideal as a power supply for sensors.

The S82J is a popular and economical power supply with a power range up to 150W. Models are available with or without covers. Each is provided with mounting brackets.

Omron's S82R is a multi-channel output, economical and easy to use power supply with 100 or 240V AC input and two output channels at 30, 50 or 75W, an ideal built-in power supply for electronic devices. Surface mounting as well as bottom and side mounting is possible. Also two types are available, independent control or secondary control.

For further information circle 204 on the reader service coupon or contact DGE Systems, 103 Broadmeadow Road, Broadmeadow 2292; phone (049) 61 3311.

40A charger is micro based

Deep cycle battery banks that provide power for boats and caravans need proper charging to maintain their rated performance and life.

The Truecharge 40i from Statpower is a 40A 'smart' charger that the user can 'connect and forget'. It quickly recharges up to two battery banks, and knows when to stop charging so it won't damage the cells.

Microprocessor technology regulates the voltage and current delivered to the battery. A three stage charging process starts with a charge, to replace 70 - 80% of the battery's capacity at the fastest possible rate. An absorption charge then steadily decreases the charging current while maintaining battery voltage to replenish the remaining capacity. Once the battery is fully replenished, a float cycle begins. The charger also supplies current to loads connected to the battery during this cycle, reducing battery drain.

The unit measures 38 x 17 x 7cm. A bar graph displays charging current, and indicator lights show when the battery is fully charged. The charger accommodates 12 volt lead acid batteries from 100 amp hours to 400 amp hours. Output charge is from 13.8 to 14.8 volts DC. Float charge is from 13.1 to 14.2 volts DC.

For further information circle 201 on the reader service coupon or contact Statpower Australia, 77 Shore Street, Cleveland 4163; phone (07) 821 3333.



DC-DC converters

Melcher has released its new IMR family of DC-DC converters in the power range of 3, 6, and 15 watt. The converters can be installed anywhere in industry, where the environmental conditions such as temperature, EMC and mechanical ruggedness are less demanding.

The units are available with single or double outputs of 5, 12 or 15V DC and with 2:1 input voltage ranges. The high switching frequency gives a compact design which allows direct and flexible integration into printed circuit boards. The operational safety is raised significantly by output open circuit and short circuit protection, as well as galvanic input or output isolation. The circuit design allows connection of several units either in series or in parallel.

All converters in the IMR family conform to the appropriate international safety standards with an input to output isolation of 500V DC and EMI values according to EN 55022 level A.

For further information circle 206 on the reader service coupon or contact Scientific Devices Australia, 2 Jacks Road, South Oakleigh 3167; phone (03) 579 3622.



UPS with enhanced comms

Optiquest have recently introduced a new Enhanced OPTI-UPS (E) series of line interactive UPS offering Enhanced Interface (EI) communications. The compact units provide superior performance and battery back up for complete power protection, including line conditioning and surge protection, for networked, stand-alone personal computer and workstations from power interruptions such as blackouts, sags, surges, noise and brown-outs.

The OPTI-UPS E series offers sine wave, automatic voltage regulation (AVR) and provision for optional OPTI-SAFE+ communications software. All Optiquest UPS are UL, CSA and VDE approved and guaranteed for two years.

The OPTI-SAFE+ software permits the user to monitor input/output voltage, AC input/output frequency, battery voltage/capacity and percent load in either a dashboard gauge or functional block diagram format.

When a power failure occurs, OPTI-SAFE+ alerts users on the network to save their work, and broadcasts an alarm message at short intervals. Self diagnostics, automatic startup and shutdown audible alarms, including low battery alarm are a few of the added features.

For further information circle 210 on the reader service coupon or contact the appointed distributor, Anton Piller (Aust); phone (03) 9562 8466.

GOULD



Gould EasyScope 340...

It's a DSO...

- 20MHz, 20MS/s, 2k Horizontal Waveform Memory
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- 20 Display Memories

It's a DMM...

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- Vac, Vdc, A, Ω, Diode
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It's a COUNTER...

- 20MHz Range
- Seven Digits
- 0.001% Accuracy
- Period Measurement

It's a LOGIC ANALYSER...

- 20 MHz Clock
- Eight Channels
- Timing/State Display
- TTL/CMOS Triggering

It Fits In Your Hand...

The Gould EasyScope 340 is a portable, integrated test instrument which combines the most-needed functions of several instruments in one compact package. It features a back-lit high resolution LCD display, RS-232 plus printer interfaces. It is supplied complete with probes, protective rubber holster, rechargeable batteries and carry case.

It measures 287x152x82mm and weighs only 2.0kg.

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READER INFO NO. 44

Power Supply Products

720W switcher in 19" rack

Melcher has announced the PSK family of switching regulators. Providing from 5V 25A up to 36V 16A and with wide input ranges up to 80V DC, the products offer a very compact solution for industrial applications, in both chassis and 19" rack mounting formats, which require no galvanic isolation.

With conversion efficiencies ranging from 80 to 96%, the units can operate in an ambient temperature range of -25 to +71°C without derating, and require no additional heatsinking or forced air cooling. They can be powered from rectifiers, batteries, or semi-regulated power sources, and provide a tightly regulated, low noise output with excellent dynamic response capability.

Continuously short and open circuit proof, the supplies provide standard features such as sense lines, true current share for parallel operation, inhibit, and user setting of the output to any value up to 41.5V DC. All units are UL and C-UL recognised, SEV approved, and fully compliant with safety and EMC standards EN60950 and EN55022 respectively.

For further information circle 210 on the reader service coupon or contact Scientific Devices Australia, 2 Jacks Road, South Oakleigh 3167; phone (03) 579 3622.

750W switcher

The Kepco RCW series is a group of seven 750 watt industrial grade single output switching power supplies that incorporate FET based forward converters. These fan cooled modular style switchers have adjustable outputs based around nominal voltages of 3.3, 5, 12, 15, 24, 28 and 48V DC, able to source currents of 15 to 150A, depending on the model.

They can be operated at temperatures ranging from -10 to 471°C, delivering full power at 50°C, with humidity up to 95%RH (non-condensing).

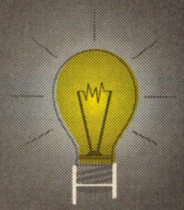
With a switching frequency of 160kHz, the RCW converters provide high efficiency at either 240 or 120V AC and the input voltage (which can be anywhere between 85 and 264V) is sensed automatically. An EMI filter is built-in so that conducted noise meets FCC Class A limits.

In addition, an active power factor correction circuit ensures that current is drawn over the entire mains cycle so that with a power factor of 0.99, the RCW meets the IEC's harmonic current limit (IEC 555-2). Construction of the RCW series conforms to UL 1950, CSA 1402C and the norms of EN60950.

Output voltage is adjustable via an internal multi-turn potentiometer or can be externally programmed using a variable resistance connected by a shielded cable, which can be up to two metres long. The units can also be turned on and off remotely using TTL level control.

The supplies are housed in a 110mm high steel and aluminium case, on a 200 x 240mm footprint. They are provided with a five year warranty.

For further information circle 207 on the reader service coupon or contact Obiat, PO Box 37, Beaconsfield 2014; phone (02) 698 4111. ❖



DON'T GET CAUGHT IN THE DARK!

Whenever there's a power failure you could find yourself literally in the dark, looking at a blank screen having just lost your data. An uninterruptable power supply (UPS) will provide back up power for approximately 10-15 minutes depending on load, allowing sufficient time for the operator to save files and perform an orderly shutdown. Optional software can also save your working files and shut down the computer automatically when the battery power within the UPS has become low.

A UPS will effectively protect expensive equipment from sags and surges as it filters and regulates input power.

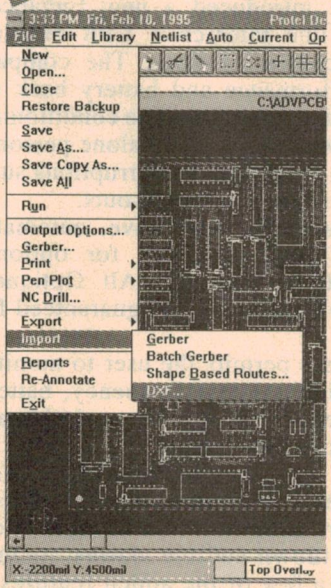
A UPS unit is your best protection against power loss.

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READER INFO NO. 46

For a wider choice of power supplies...

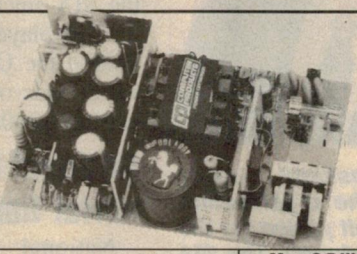
Amtex brings you the world-famous, internationally proven 'Computer Products' range of power supplies – a leader in the field since 1968.

Our Ex-Stock range of around 60 compact models makes it easy for you to specify the most efficient, most cost-effective solution for your power conversion needs.

Quality and reliability are outstanding, as all units are made to the most advanced designs, thoroughly computer tested, then individually burnt in.

Here are a few of our most popular models:

Universal Input (90-264VAC) 25W-75W



- MTBF > 100,000 hours
- Single output versions available on NFS40 series

Model	Output Voltage & Max. Current	Max. O/P Watt	
		Free Air	Forced Air
NFS25-7608	+5.1V,2.0A; +12V,1.5A; −12V,0.2A	25W	–
NFS25-7628	+5.1V,2.0A; +12V, 0.2A; −12V,0.2A	25W	–
NFS40-7607	+5.1V,5.0A; +12V,2.0A; −5V, 0.5A	40W	50W
NFS40-7608	+5.1V,5.0A; +12V,2.0A; −12V,0.5A	40W	50W
NFS40-7610	+5.1V,5.0A; +15V,2.0A; −15V,0.5A	40W	50W
NFS40-7628	+5.1V,5.0A; +12V,0.5A; −12V,0.5A	40W	50W
NFS42-7608	+5.1V,3.5A; +12V,2.5A; −12V,0.3A	40W	–
NFS42-7610	+5.1V,3.5A; +15V,2.0A; −15V,0.3A	40W	–
NFS42-7627	+5.1V,3.5A; +24V,1.2A; −12V,0.3A	40W	–
NFS50-7608	+5.1V,7.0A; +12V,2.5A; −12V,0.7A	50W	60W
NFS75-7608	+5.0V,5.0A; +12V,3.0A; −12V,1.0A	75W	–

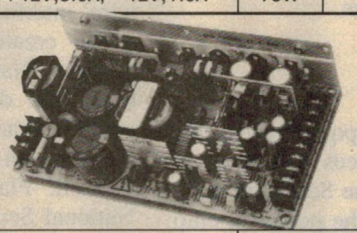
DC-DC Converter



(S) = Single output
(D) = Dual output
(T) = Triple output

Series	Input Voltage	Output Voltage	Max Output Power	Size L x W x H mm
PM600	5V; 12V	5V,0.1A/12V,0.08A(S)	1W	32 x 20 x 10
PM600	5V; 12V	±12V,.04A/±15V,.033A(D)	1W	32 x 20 x 10
A	5v; 12V; 24V; 48V	±12V,0.15A/±15V,0.15A(D)	4.5W	51 x 51 x 10
F	5V; 12V; 48V	5V,1A/12V,0.5A/15V,0.35A(S)	6W	51 x 51 x 10
AFC5	5V; 12V;	5V,1A/12V,0.4A/15V,0.35A(S)	5W	51 x 26 x 10
AFC5	5V; 12V	±12V,0.15A/±15V,0.15A/(D)	5W	51 x 26 x 10
PM900	5V; 12V; 24V; 48V	5V,1A/±12V,0.23A	5.5W	51 x 51 x 10
PM900	5V; 12V;	15V,0.4A/±15V,0.19A	6W	51 x 51 x 10
NFC40	24V; 48V	5V,8A/12V,3.5A/15V,2.8A(S)	40W	56 x 56 x 21
NFC40	24V; 48V	5V,7.5A; ±12V,0.75A(T)	40W	56 x 56 x 21
NFC40	24V; 48V	5V,7.5A; ±15V,0.75A(T)	40W	56 x 56 x 21

Universal Input (90-264VAC) 80W-350W

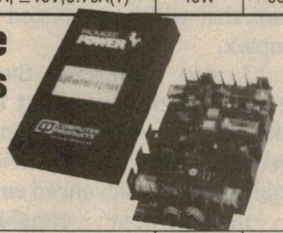


- MTBF > 65,000 hours
- Single output versions available on NFS110 series

Model	Output Voltage & Max. Current	Max. O/P Watt	
		Free Air	Forced Air
NFS80-7602	+5.0V,12A; +24V,2.5A; +12V,3A; −12V,3A	80W	110W
NFS80-7606	+5.0V,12A; +24V,2.5A; +15V,3A; −15V,3A	80W	110W
NFS110-7601P	+5.1V,10A; +12V,5.0A; −12V,1A; −5.0V,1A	80W	110W
NFS110-7602P	+5.1V,10A; +24V,4.5A; +12V,5A; −12V,1A	80W	110W
NFS110-7604P	+5.1V,10A; +15V,5.0A; −15V,1A; −5.0V,1A	80W	110W
NFS200-7601	+5.1V,30A; +12V,8.0A; −12V,4A; −5.2V,6A	–	200W
NFS200-7602	+5.1V,30A; +12V,8.0A; −12V,4A; 24V,3A	–	200W
NFS200-7603	+5.1V,30A; +12V,8.0A; −12V,4A; 12V,4A	–	200W
NFS200-7608	+5.1V,30A; +12V,8.0A; −12V,4A	–	200W
NFS350-7608	+5.1V,50A; +12V,12A; −12V,5A	–	350W
NFS350-7625	+5.1V,50A; +12V,12A; −12V,5A; (Note 1)	–	350W
NFS350-7626	+5.1V,50A; +12V,12A; −12V,5A; (Note 2)	–	350W

Note 1: 4th floating output is adjustable 4.5V-16.5V, 4A
Note 2: 4th floating output is adjustable 15V-30V, 4A
*Absence of "+" or "−" indicates a floating output

Wide Input Range DC-DC Converters



(S) = Single output
(D) = Dual output
(T) = Triple output

Series	Input Voltage	Output Voltage	Max Output Power	Size L x W x H mm
DR	18-36V	5V,0.5A/12V,0.25A(S)	2.5W	32 x 20 x 13
DR	18-36V; 36-72V	±12V,0.125A/±15V,0.1A(D)	3W	32 x 20 x 13
FW	36-72V	5V,1.5A/12V,0.625A(S)	7.5W	51 x 51 x 10
FW	36-72V	±12V,0.315A/±15V,0.25A(D)	7.5W	51 x 51 x 10
NFC15	20-72V	5V,3A/12V,1.25A/15V,1A(S)	15W	51 x 41 x 12
NFC15	20-72V	±12V,0.625A/±15V,0.5A(D)	15W	51 x 41 x 12
ES	18-36V; 36-72V	+5V,1.5A; ±12V,0.31A(T)	15W	76 x 66 x 21
ES	18-36V; 36-72V	+5V,1.5A; ±15V,0.25A(T)	15W	76 x 66 x 21
NFC25	36-72V	+5V,5A; ±12V,1.0A(T)	25W	76 x 76 x 10
NFC25	36-72V	+5V,5A; ±15V,0.8A(T)	25W	76 x 76 x 10
WRU	36-72V	+5V,5A/12V,2.5A/15V,2A(S)	30W	116 x 66 x 21
WRU	18-36V; 36-72V	±12V,1.25A/±15V,1A(D)	30W	116 x 66 x 21
WRK	18-36V; 36-72V	5V,10A/12V,5A(S)	60W	140 x 99 x 23
WRK	18-36V; 36-72V	+5V,5A; ±12V,1.25A(T)	55W	140 x 99 x 23
WRK	18-36V	+5V,5A/±15V,1A(T)	55W	140 x 99 x 23

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READER INFO NO. 47

Silicon Valley NEWSLETTER



Motorola dedicates 'greener' chip fab

The largest single asset ever developed by Motorola has formally opened in Austin, Texas where the company opened the doors of its US$1 billion 'MOS 13' semiconductor production fab. The facility features new chemical processing systems that will enable Motorola to recycle much of the dangerous gasses and liquids it uses in the chip production process.

The new fab, one of the most advanced in the world, will be used to manufacture Motorola's Power PC microprocessors. Its laboratory will also be a centre for creating advanced processes for manufacturing future generations of integrated circuits.

"MOS 13 and the APRDL (Advanced Products Research Development Laboratory) are our pathfinders to the next generations of technology", said Barry Waite, the Motorola executive whose business group designs and sells the circuits that will be produced in the new complex.

MOS 13 also represents the first example of an aggressive effort by the chip maker to make its production operations more environmentally friendly. The complex features advanced environmental management capabilities, includes reprocessors that will recycle and distill more than 90% of the sulphuric acid used in wafer cleaning at the plant. Water conservation systems designed to capture, filter, and recycle water into a variety of ancillary processes are also incorporated into MOS 13, as are double-contained chemical storage vaults and just-in-time chemical delivery systems to reduce on-site storage.

Construction of the 800,000-square-foot complex was initiated in the fall of 1993. More than 1500 Motorola employees and contractors worked on the project, which includes more than 18 miles of heating, ventilating, and cooling ducts and more than 104 miles of electrical conduit. At full production, the facility will employ 900 to 1,000 employees.



Retiring SIA president Andy Procassini steered the organisation through a very difficult period for the US semiconductor industry. The SIA was on the verge of collapse when he took over the position.

The first runs of silicon wafers have already been produced in the new facility with initial good-part yields of 62% — unusually high for such an early test of a new production line.

Ex-AMD lawyer to head SIA

The former chief corporate lawyer for Advanced Micro Devices will serve as the new president of the Semiconductor Industry Association, the powerful chip industry trade group that handles government affairs for the US chip industry. From September 5, Thomas Armstrong, 55, is replacing Andrew Procassini, who plans to retire at year-end.

Armstrong is best known as AMD's lead attorney during the eight-year legal war between AMD and Intel over the rights to the x86 microprocessor. He served as general counsel for AMD from 1983 to 1994. When he left, he said the stress of the fight with Intel had worn him down. Prior to AMD, he worked for Schlumberger/Fairchild, the Boston-based Sullivan & Worcester law firm, and before that the U.S. Securities and Exchange Commission.

"We look forward to Tom carrying forward the agenda that has helped the US semiconductor industry regain its worldwide market share leadership during the past 10 years", said Gil Amelio, chairman of chip maker National Semiconductor Corp. and head of the SIA search committee.

Procassini, 66, has been president of the SIA since 1985. During his tenure, the SIA played a key role in helping turn around the US semiconductor industry, which was on the verge of collapse in the late 1980s.

National launches serial flash chip

National Semiconductor has announced a US$600 million expansion at its South Portland, Maine, facility for the company's first state of the art 0.25 micron-capable eight inch wafer manufacturing plant. National also said it is expanding its family of Flash products with a 4Mb 'Serial Flash' device, which combines NAND Flash technology with National's industry standard 'Microwire' interface.

"To create the most cost effective solution, National studied the applications and discovered what trade-offs could be made in hardware or silicon vs. firmware in the processor," said Rob Frizzell, Flash marketing manager at National Semiconductor. "The result is the smallest 4Mb die for the technology. This will allow the device to be priced well under $10."

National expects to be in production on the 4Mb device by the end of the year. Future versions with higher capacity and lower voltage will be announced in 1996.

Meanwhile, National's new 8" wafer plant is part of more than US$1.3 billion investment it has committed to new manufacturing facilities this year, and represents one of Maine's largest single business investments.

The 0.25 micron CMOS facility is being built to meet the increasing worldwide demand for semiconductors. "The investment in CMOS and 0.25 submicron

technology puts National in a position to take advantage of the explosive growth in moving and shaping technologies that are required for ongoing development of consumer and business products," said Gilbert Amelio, National's president, chairman and chief executive officer.

Microsoft to enter TV market?

Microsoft is reportedly negotiating to take a US$1-2 billion stake in Turner Broadcasting System, and could become indirectly embroiled in a battle for control over the CBS TV and radio network. Ted Turner, owner of the TBN network and Microsoft's chairman Bill Gates reportedly met recently in the Seattle area to discuss their plans.

Wall Street analysts speculate the investment could give Turner the firepower he needs to make a bid for CBS, which has already accepted a $5 billion bid from Westinghouse. Turner has long sought a broadcast network, but has been stymied thus far from following through on his plans.

Microsoft, which is in the process of rolling out its own on-line information service, is said to be interested in acquiring access to the CNN brandname as well as the TBS video library. If a deal were to be struck, TBS videos could appear on the Microsoft Network, increasing the value of the on-line computer network.

Ramtron & Toshiba to develop FRAM memories

Ramtron International, founded originally in Australia, has agreed to jointly develop and manufacture its FRAM (ferroelectric random access memory) chips with Toshiba. This technology produces high-performance memories, which do not lose data when power is removed.

Under the terms of the agreement, Ramtron will grant Toshiba a non-exclusive license to Ramtron's FRAM technology as well as know-how, in exchange for certain licensing considerations by Toshiba. Ramtron now has three alliance partners actively engaged in ferroelectric FRAM memory development.

"This agreement with Toshiba provides further evidence of the industry momentum toward ferroelectrics. Ramtron's goal is to maintain its leadership role in FRAM technology and products. We can only achieve this goal by working in cooperation with the world's foremost semiconductor companies," said Ramtron chairman David Sikes. "We are very pleased that Toshiba has joined with Ramtron to develop ferroelectric memory products and markets," he said.

Ramtron's FRAM memories combine the high speed of DRAM (Dynamic Random Access Memory) and SRAM (Static Random Access Memory) with the non-volatility of ROM (Read Only Memory) — features that at present are not available in any single semiconductor memory device.

Other nonvolatile memory technologies such as EEPROM (electrically erasable programmable read only memory) and Flash memory cannot be reprogrammed at high speeds, require more power to operate, and wear out after fewer rewrite cycles when compared to FRAM memories.

Ramtron had 1994 revenues of US$20.1 million. The company holds 55 foreign and domestic patents for its proprietary technologies and products.❖

Windows 95: You will be assimilated — resistance is futile

There should have been protest marches outside the thousands of computer retail outlets on August 24. Protests about Windows 95 being a year or two late, for not bringing users any new breakthrough capabilities, and for requiring users to part with hundreds of dollars to upgrade their systems or find themselves with the equivalent of a white elephant...

But instead of protests, there were long lines outside every computer retailer in the world — many opening their doors a few nanoseconds after midnight to enable users to be among the first of the expected 100 million PC users who will end up paying Bill Gates this year's operating system upgrade tax.

On the first day, several million copies of Windows 95 were sold as retailers had trouble keeping up with demand. At the chain of Fry's Electronics stores in Silicon Valley, shelves had to be restocked about every 15 minutes throughout the day. Many computer retailers reported record sales. On Wall Street, Microsoft shares rose the next day as analysts said they now expect the company to sell as many as 30 million Windows 95 copies in the first year, up from an earlier estimate of 15 million.

The official Windows 95 launch took place in a huge complex of tents outside Microsoft's Seattle headquarters complex, where some 2500 invited guests witnessed the historic event that started off with the Rolling Stones hit 'Start Me Up' pounding the crowd.

Bill Gates himself officially unveiled Windows 95, saying the software would usher in a new era in personal computing. "This is a platform for new technology," Gates said. "It moves the PC to a whole new level."

Gates beamed at his audience, which also included some 70,000 people in various locations around the world connected to Seattle by satellite.

He said that all of Microsoft's divisions "have an incredible wave of cool products" coming along, to run with Windows 95 and its successors, Windows NT or Windows 97. Popular late-night TV talk show host Jay Leno was hired to lend some humour to the event and to give the first major demonstration of Windows 95.

"Windows 95 is so easy that even a talk show host can use it", Gates told Leno before the demo. Leno responded jokingly, saying "I'm kind of a computer virgin here, Bill. As we go through this I hope you'll be gentle."

Leno also poked fun at Gates, as the software company executive soberly touted the features of the system. "Bill is not necessarily so different from the rest of us", Leno said. "I went into his den last night, and his VCR is still flashing 12:00."

If one thing was overwhelmingly clear from the hype of the US$200 million Windows 95 launch, it is that the future almost certainly will belong to Microsoft — whose festivities left just about anyone in attendance with a feeling of the inevitability of a Windows-only computing world.

IBM once named a pre-release version of its OS/2 operating system 'Borg', after the Star Trek alien race that assimilated every race with which it came in contact. But on August 24 IBM was invisible, at best a pathetic whimper drowned by the cheers for Windows 95 — part of a Windows strategy that really does bring to mind the Borgs' best line: "Resistance is futile".

Other Microsoft enemies have already capitulated. In one of the tents at the Windows 95 launch was Philippe Kahn, one of Bill Gates' most vocal adversaries just a couple of years ago when he was running Borland International and making an ill-fated run for desktop leadership. Kahn, looking more chipper than he must have felt given Microsoft's victory, was showing the Windows 95 versions of software developed by his new company, Starfish.

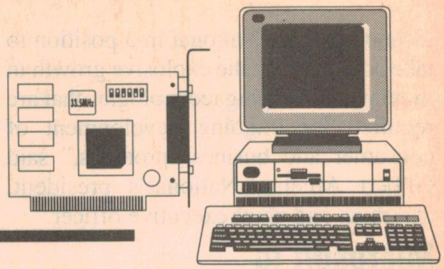
Then there was Jerry Sanders of Advanced Micro Devices, insisting that the carnival was an "event worthy of the product". AMD has bet much of its future on making its processors 'Windows compatible', rather than Intel-compatible.

One observer at the Windows 95 launch described the event as "How the Ten Commandments would have been launched, if only God had Bill Gates' money."

But while most of the initial attention was being paid to home customers of Windows 95, it is the business market that will make or break the product, since three out of every four sales dollars at Microsoft are from businesses.

As a result, said Dataquest analyst Karl Wong, the ultimate success of Windows 95 won't be known for six months or a year — the time it takes for cautious business customers to decide if they want to upgrade.

Computer News and New Products

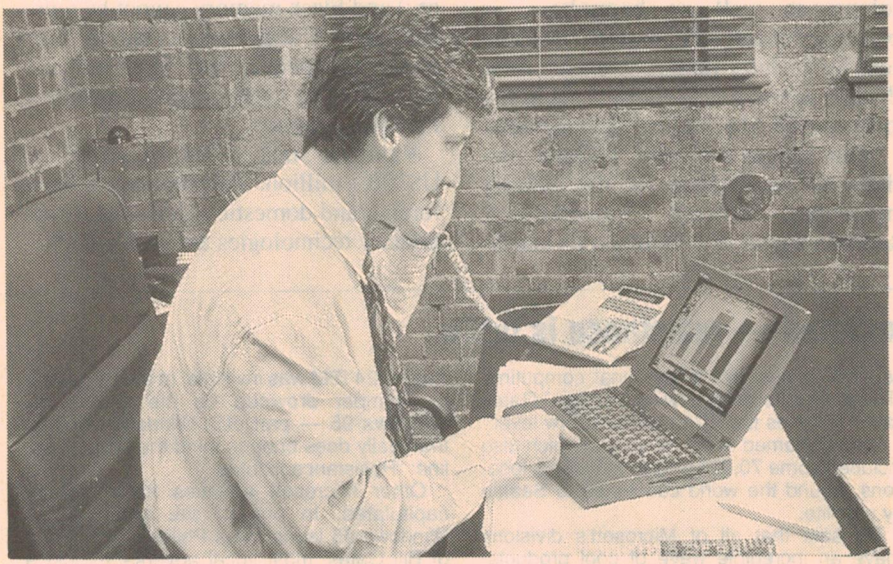


486 notebooks

Sharp Corporation of Australia has released two new 486 notebook computers, the Colour Star PC3010 and PC3050. Both computers incorporate a pointer device called GlidePoint, replacing the usual mouse or track ball.

Both computers feature a DX2/66MHz 486 processor, 4MB RAM (expandable to 32MB), a 26cm colour passive matrix screen, 3.5" disk drive, GlidePoint fingerpad and slots for PCMCIA card types II and III.

The PC3010 has a removable 320MB hard disk while the PC3050 has a removable 500MB hard disk and includes a multimedia sound system with built-in stereo speakers and microphone. The computers come with a three year warranty, and prices start at less than $3000.



For further information circle 170 on the reader service coupon or contact Sharp Corporation, PO Box 827, Blacktown 2148; phone (02) 831 9111

Fibre optic modem

The OSD155 RS-485 modem from Optical Systems Design is a small robust unit for use in industrial links, secure communications and access systems. A unique feature is its half duplex operation over a single optical fibre, which gives cost savings compared to conventional two-fibre products.

A pair of OSD155 short-haul modems and a simplex fibre optic cable form a link that is a direct replacement for twisted pair extension cables. This link is an effective way of extending cables while providing EMI/RFI protection, data security and elimination of ground loops.

The modem supports half duplex data rates of between DC and 40kb/s, but is optionally available at rates up to 150kb/s. The OSD155 can operate over at least 2km of standard multi-mode communications fibre optic cable and the OSD155L can operate over at least 10km of single mode fibre.

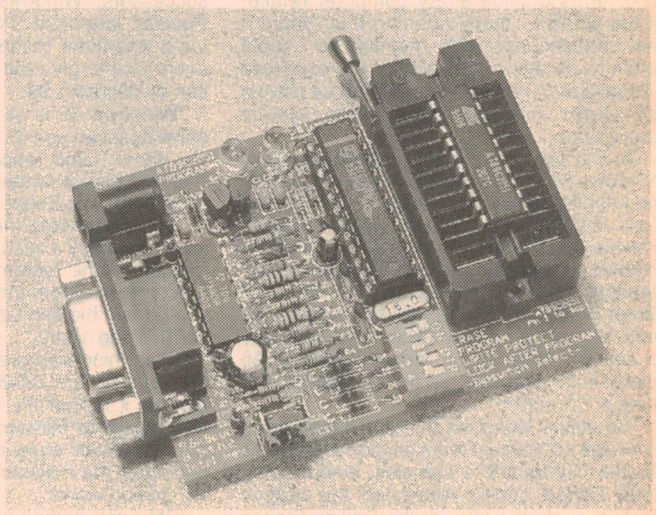
For further information circle 177 on

Programmer for AT89C2051 micro

Microprocessor product design firm AirBorn Electronics has released the PG2051, a development programmer for the AT89C2051 microprocessor. The AT89C2051 is a 20-pin 8051 compatible microprocessor with 2KB of Flash memory. The PG2051 erases, programs and verifies an AT89C2051 in six seconds.

The programmer is connected to a PC or other host by a serial cable, with data being downloaded to the programmer in Intel Hex format. The programmer will test, erase, program, verify, write protect and security protect as it receives the file, according to DIP switch settings. The programmer also has a test switch to check if an AT89C2051 is blank, working, programmed or faulty, without needing a PC to be connected.

The RRP of the PG2051 programmer is $188 (excl tax). The RRP of an evaluation kit including the programmer, two AT89C2051s, prototyping PCB and disk with sample software is $233.



For further information circle 175 on the reader service coupon or contact AirBorn Electronics, PO Box 1491, North Sydney 2060; phone (02) 9925 0325.

the reader service coupon or contact Optical Design Systems, PO Box 891, Mona Vale 2103; phone (02) 913 8540.

Pentium single board computer

The SB586TCP from Industrial Computer Source is a single board computer based on the Intel Pentium processor and Peripheral Component Inter-connect (PCI) local bus developed by Intel. The board includes a Pentium 90 or 100MHz CPU, floppy drive controller supporting two floppy drives up to 2.8MB, an IDE and PCI local bus SCSI-2 controller, two 16550 compatible serial ports and a Centronics bi-directional parallel port. The SCSI controller includes drivers for DOS, Windows and OS/2. As well, the board has a resettable watchdog timer, 256KB cache RAM and takes up to 128MB of on-board RAM.

It comes with AMI WinBIOS and uses the Intel Neptune chipset. PCI local bus clock rate is 30MHz, and the ISA bus speed is 8MHz.

For further information circle 169 on the reader service coupon or contact Interworld Electronics, 1000 Glenhuntly Road, Caulfield South 3162; phone (03) 9563 5011.

20km from single mode fibre LAN module

IMC Networks has announced the S2MM/1320 and S2MM/8520, high powered single-mode optical fibre module sets for its FibreConverter range of modular fibre networking products.

The new module has a power budget of 21dBm and can be used to connect local area networks over more than 20km of single-mode fibre.

Most single-mode fibre optic networking solutions have power budgets in the order of 8-9dBm, which limits single-mode fibre distance to between two and 8km.

The IMC FibreConverter is designed to convert single-mode (1300nm) to multi-mode (850nm or 1300nm) fibre and vice versa. The conversion is transparent to any protocol and the media converter can be used for Ethernet, Full Duplex Ethernet, Fast Ethernet, FDDI, Token Ring or SONET/ATM conversion.

For further information circle 172 on the reader service coupon or contact Digital Networks Australia, 71 Chandos Street, St. Leonards 2065; phone (02) 437 5177. ❖

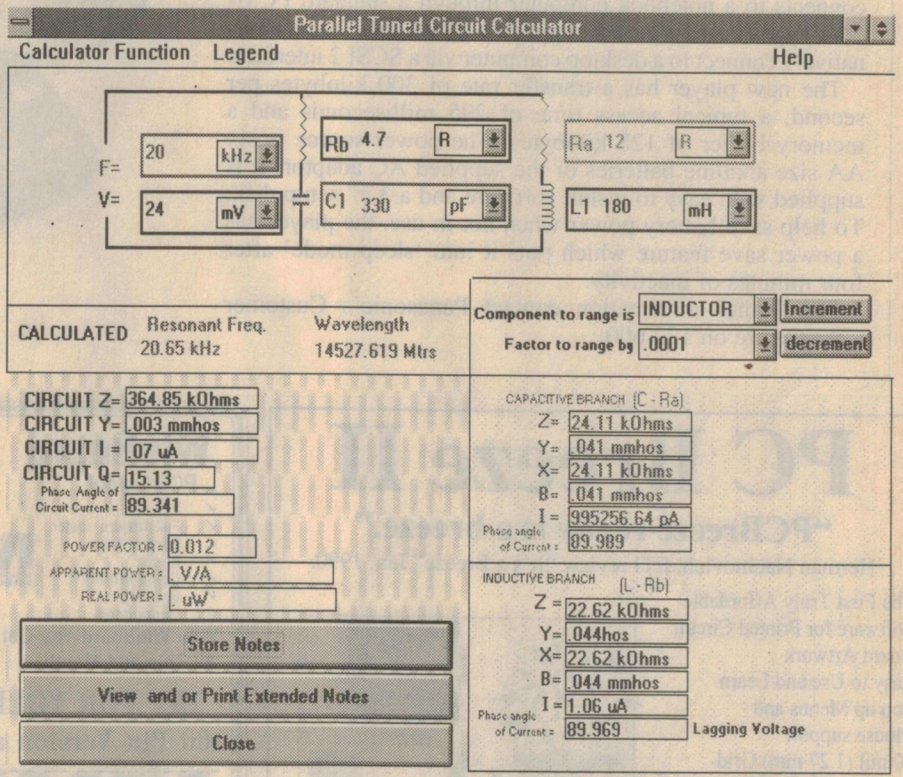
Windows based circuit calculators

Software author A.R. Newnham has recently released a suite of circuit calculators that run under Windows, to aid in the design of LCR and 555 circuits.

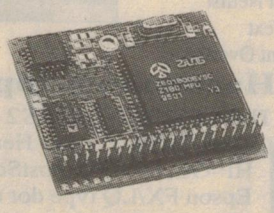
The four 555 timer IC calculators provide a simple and intuitive means to calculate component values for astable, bistable and monostable circuits, as well as an easy to use series/parallel value component calculator. These four calculators are being offered as freeware by the author, as an incentive to purchase the second group of utilities, the Tuned Circuit Calculators.

The seven tuned circuit calculators display power, phase angle, admittance and resonant frequency, as well as the total impedance and reactance of almost any tuned circuit. By using a simple 'point and click' system for selecting component values, and storing the results of all calculations for later printing, the author has produced a comprehensive and easy to use set of software tools that will have application in almost every aspect of circuit design.

The Tuned Circuit Calculators are available from A.R. Newnham, 'Barrenjoey', Osbourn St., Bundanoon NSW 2578 for $20, including postage. The 555 calculators are available from the same address for $6 (covering postage and packaging), or, if you have a modem, from the *Electronics Australia* BBS on (02) 353 0627.



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COMPUTER NEWS

New SPICE library has PWM ICs

Intusoft has introduced a new SPICE model library for power supply designers, claimed as the first SPICE library to contain a comprehensive set of switching level models for pulse width modulation (PWM) ICs.

The new library is claimed to represent a major breakthrough for SMPS designers as previous models were based almost exclusively on state space average models, which don't show many important non-linear effects. It also has a unique 'unified' state space PWM model which works for AC, DC, and transient analyses in continuous and discontinuous modes. However, the switching level models allow designers to plug in a model of the actual IC, and simulate the transient switching performance accurately and realistically. Included are over 20 voltage and current-mode PWM IC models for parts from Unitrode (UC184x series, UC152x series and UC182x series), Linear Technology (LT124x series), Siliconix (Si9145), and Cherry Semiconductor (CS322/324). The library also includes SPICE models for non-linear magnetic cores (Magnetics MPP series and various European cores). For further information circle 178 on the reader service coupon or contact ME Technologies, PO Box 50, Dyers Crossing 2429; phone (065) 50 2254. ❖

Portable 2X CD-ROM player

Panasonic has launched a new, completely portable double speed CD-ROM player which connects to a notebook or desktop computer. Called the KXL-D720, the CD-ROM player connects to a notebook computer through a standard PCMCIA Type II card which is supplied with the unit. It can alternatively connect to a desktop computer via a SCSI 2 interface.

The new player has a transfer rate of 300 kilobytes per second, a typical access time of 295 milliseconds and a memory buffer of 128 kilobytes. The power source is six AA size alkaline batteries or the supplied AC adaptor. It is supplied with easy to install software and a 3.5" setup disk. To help save battery power when not in use, the player has a power save feature which puts it into 'sleep mode' after four minutes of inactivity.

For further information contact Panasonic's Customer Care Centre on 132 600.



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Herman Nacinovich, ETI review "It's a Breeze" Jan. 1990.

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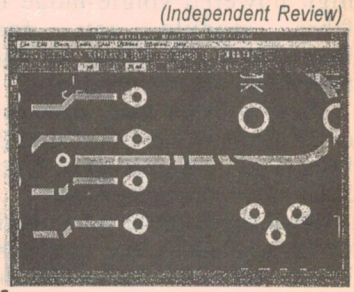
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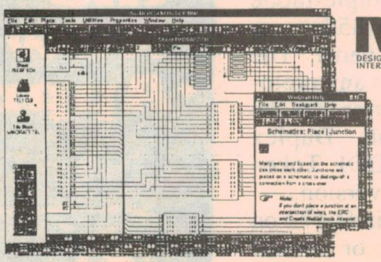
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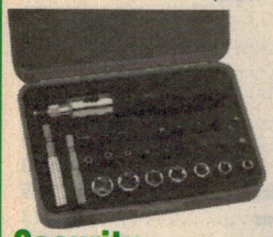
New Tools Serviceman's Tool Sets

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TSA59 **$126.95**

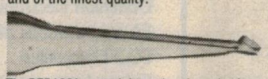


Security Screwdriver Set

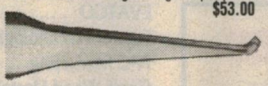
You know how frustrating it is to be fixing something only to find that one of the screws has a security head and your normal screwdrivers won't fit? Well here's the kit for you. It has a ratchet handle and 8 sizes of security torx bits plus 17 other screwdriver, nut and socket bits and an extension handle. Complete in handy plastic case.
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SMD Tweezers Added

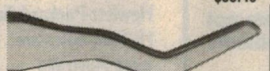
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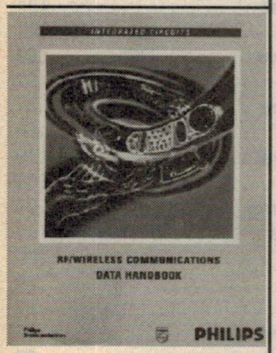


Mini Vice

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Philips Data Books

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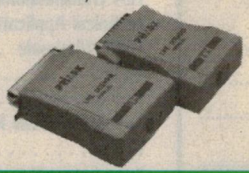
RF/Wireless Communications
This huge data book runs to almost 1500 pages and is split into 10 sections. These cover RF front-ends, paging receivers, amplifiers, IF systems, frequency synthesisers, prescalers, transmitters, basband processors (audio and data), compandors and wireless system solutions. In addition to specifications there are also useful application notes. Essential for anyone involved in the RF part of the spectrum.
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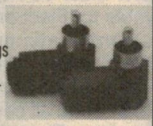


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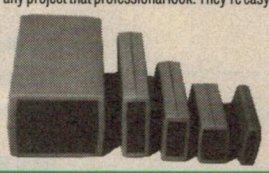
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CAS-D25M/RJ45-SKT	D25M to 8 Pin RJ Skt	$5.45
Data Switches		
CAS-SWB-09-AB	9 Pin Data Switch	$36.55
CAS-SWB-25-ABCD	RS232 Data Switch	$44.95
CAS-SWB-25-AB	RS232 Data Switch	$25.95
CAS-SWB-25-AB-X	RS232 CrossoverSwitch	$48.95
CAS-SWB-36-AB	2 Way Centronics Switch	$32.95
Computer Leads		
CL-CEN36M/CEN36M	2m 36 Way Centronics	$14.95
CL-D09F/D09F-2	2m D09 Skt to D09 Skt	$14.95
CL-D09M/D09M-2M	9 to 9 M/M	$9.95
CL-D09F/HDD0915M	2m 9 Skt to 15 Plg	$11.95
CL-D0915F/D0915M	2m High Density	$12.95
CL-D0915M/D0915M	3m High Density	$11.95
CL-D09F/D25M-2	2m 9 Skt to 25 Plg	$13.95
CL-D15F/D15M-2M	2m D15 Skt to D15 Plg	$8.95
CL-D25F/D25M-2M	2m D25 Plg to Skt	$13.95
CL-D25F/D25M-5M	5m RS232 Extension Lead	$19.95
CL-D25M/D25M-2M	2m DB25 Plg to Plg Lead	$13.95
CL-D25M/D25M-5M	5m D25 Plug to Plug	$17.50
CL-D25F/D25F-NM	2m Null Modem F/F	$11.95
CL-KEYBOARD-EXT	Keyboard Extn Lead	$7.95
CL-SCSI-25/50-1	1m 25D to 50 Centronics	$25.20
CL-SCSI-25/50-2	2m 25D to 50 Centronics	$17.15
CL-SCSI-50/50-1	1m 50/50 Centronics	$30.25
CL-SCSI-50/50-2	2m 50/50 Centronics	$18.15
Printer Leads		
CL-PRNTR-ST-1.8M	1.8m Printer Cable	$8.05
CL-PRNTR-ST-5.0M	5m Printer Cable	$13.10
CL-PRNTR-ST-10M	10m Printer Cable	$26.25
Communications Cables		
CL-ETHERNET-5M	5m Ethernet Cable	$10.05
CL-ETHERNET-10M	10m Ethernet Cable	$19.15
CL-ETHERNET-20M	20m Ethernet Cable	$19.95
CL-D09F/D25F-LL	2m 2xD25F to 2xD09F Lap	$17.95
CL-D25M/D25M-PRL	2m D25 Plg to Plg Prlel	$19.95
CL-DINSD5/RJ11P	5 Pin DIN Skt to RJ11 P	$7.90
Sundry Items		
CPEP1	Modem Protector	$60.95
CPU-STAND	CPU Stand	$25.20
FDC-1	5 1/4 Floppy Disc Clnr	$5.10
FDC-3	3 1/2 Floppy Disc Clnr	$7.15
JOYSTICK-IBM	Joystick for PC 15 Pin	$40.35
MOUSE-MAT	Computer Mouse Mat	$4.95
POWER-BRD-PAC20	6 Plug Surge Power Board	$80.95
Converters		
CAS-BIDI-CVTR	Serial/Parallel/Serial	$155.55
CAS-R2232/RS422	RS232C to RS422A Cnvtr	$97.95
CAS-RS232/RS485	RS232C to RS485 Cnvtr	$111.90

New Utility Boxes

We are now stocking five popular sizes of deluxe quality grey ABS plastic boxes. These give any project that professional look. They're easy to assemble having removable end panels and the top and bottom halves simply screw together. Guide slots are moulded in to hold PCBs



Part No	Size	Price
DUB2	90x50x16mm	$4.95
DUB4	90x50x32mm	$5.95
DUB6	90x60x30mm	$8.95
DUB8	150x80x30mm	$12.95
DUB10	190x100x60mm	$21.45

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EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

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KEY TO CODING:

A Kits and modules
B Tools
C PC boards and supplies
D Components
E IC chips and semiconductors
F Test and measuring instruments
G Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

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PROJECT QUERIES: Advice on projects is limited to postal correspondence only and to projects less than five years old. Price $7.50. Please note that we cannot undertake special research or advise on project modifications.

Members of our technical staff are not available to discuss technical problems by telephone.

OTHER QUERIES: Technical queries outside the scope of 'Replies by Post', or submitted without fee, may be answered in the 'Information Centre' pages at the discretion of the Editor.

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ADDRESS: Send all correspondence to: The Secretary, Electronics Australia, P.O. Box 199, Alexandria, NSW 2015; phone (02) 353 0620.

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STEREO SPEAKER SET

NEW Total of four speakers to make two 2-way speakers. Quality European cloth surround bass - midrange speakers, used in upmarket stereo televisions, rectangular, 80 x 200mm. Tweeters are good quality cone types, 85mm square. Two woofers & two tweeters. **$16**

MORE ITEMS & KITS

Poll our **(02) 9579 3955** fax number to find out how to get our item and kit lists. MANY MANY MORE ITEMS AND KITS THAN THOSE LISTED HERE! *Ask for these lists to be sent with your next order.*

KITS

1-CH UHF FOR CENTRAL LOCKING Our single channel UHF receiver kit has been updated to provide provision for central locking!! Key chain Tx has SAW resonator, see SC Dec 92. Compact receiver has pre-built UHF receiver module, and has provision for two extra relays for vehicle central locking function. Kit comes with two relays. **$36** Additional relays for central locking **$3** ea. Single channel transmitter kit **$18**

LOW COST 1-2 CHANNEL UHF REMOTE CONTROL compact keyring transmitter kit, 1/2 million codes, receiver has 2A relay contact output, PCB and all components kit. 1 channel Tx kit **$10**, 2 channel Tx kit **$16** Rx kit **$20** extra components for 2 channel Rx operation (extra decoder IC and relay) **$6**

ECG Solder masked and silk screened PCB and software on 3.5" disk (See EA July 95) **$9.**

MASTHEAD AMPLIFIER SPECIAL High perfomance low-noise masthead amplifier covers VHF-FM-UHF and is based on a MAR-6 IC. Includes two PCBs, all on-board components. For a limited time we will also include a suitable plugpack to power the amplifier from mains for a total price of: **$25**

PROTECT ANYTHING ALARM KIT EA May 93, PCB and all on-board components *ON SPECIAL* **$20**

4-CHANNEL UHF REMOTE CONTROL KIT: Two Tx & 1 Rx **$96.**

LASER BEAM COMMUNICATOR KIT: Tx, Rx, plus IR laser: **$60**

FM TRANSMITTER KIT - MK1 This complete transmitter kit (miniature microphone included) is the size of an AA battery, and is powered by a single AA battery. Use a two AA battery holder (provided) as the case, and a battery clip (shorted) for the switch. Battery life is over 500 hours!! **$11**

BRAKE LIGHT INDICATOR KIT: 60 LEDs, two PCBs and ten resistors, makes a very bright 600mm long, high intensity red display **$25.**

GARAGE DOOR - GATE REMOTE CONTROL KIT: SC 4/94 Tx **$18**, Rx **$79.**

1.5-9V CONVERTER KIT: $6 ea. or 3 for **$15.**

PLASMA BALL KIT: PCB and components kit, needs any 240V light bulb *ON SPECIAL* **$20.**

COMPONENTS

HIGH VOLTAGE DISC CERAMICS 680pF/3kV **20 for $4,** 15nF/3kV **$2,** 1nF/15kV **$4**

HIGH VOLTAGE DIODES high speed 1kV/1A **10 for $5**, 8kV/20mA **$1.50**, 16kV/20mA **$2**

TRIACS 600V/60A *CLEARANCE* **$3**

HIGH INTENSITY RED LEDS 550 - 1000mCd @ 20mA, 100mA max, 5mm: **10 for $4 or 100 for $30**

BLUE LEDs 5mm **$2.50**

ELECTRET MIC INSERTS High output omnidirectional standard size **10 for $8** also some high quality unidirectional electrets removed from new equipment **$3**

DYNAMIC MICROPHONE INSERTS Unidirectional low impedance **$4**

EPROMS: 27C512, 512K (64K x 8), 150ns access CMOS EPROMs. Removed from new equipment, need erasing, guaranteed, **$4.**

ULTRASONIC TRANSDUCERS High quality Murata 40kHz TX and Rx transducers **$4/pair** 40kHz crystal **$2**

3.58MHz CRYSTALS 10 for $6

OP27 OP AMP Super op amp! **$3**

ENCODER-DECODER ICs as used in many projects, SC 12/94, EA 3/93, 3/94 AX526/7/8 **$3.50** UHF module to suit **$15**

IR COMPONENTS

IR LEDs 880nm 12º 30mW @ 100mA **10 for $9** 60º type **10 for $9**, 940nm 12º 16mW @ 100mA **10 for $5**

IR DETECTOR PIN DIODE 10 for $10

IR LASER DIODE 5mW/780nm **$16**

IR LASER DIODE 40mW/830nm **$60**

DRIVER KIT, LENS & HOUSING to suit the above IR laser diodes **$14**

NOVEMBER 4 SALE!

Our once a year sale is on again at our premises on

Saturday 4th November

Many many bargains and mail order specials. Poll our fax for a price list. Mail orders accepted up to one week after the sale.

LASERS

HELIUM-NEON 633nm red laser tubes from new and near new equipment. Suitable for light shows: Output power in the range of 2.5 to 7.5mW. Includes our 12V Universal Laser power supply MkIV. (No problems with our new transformers.) *ON SPECIAL* at a reduced price of **$80** for a 2.5-4mW tube and supply. **$130** for a 40-7.5mW tube and supply.

LASER POINTER PEN A pen style laser rated at 5mW/670nm. Brighter than most pens due to its high quality lens. Metal body with a tactile switch, operates from 2AA batteries (not included). Suits medical uses. **$75**

AIR-COOLED ARGONS Used 30-100mW argon-ion head blue/green output. Includes details of power supply and other information: head only: **$350** *LIMITED SUPPLY*

VISIBLE LASER DIODE KIT 5mW 670nm visible laser diode and collimating lens, with housing and APC driver kit EA 9/94 SPECIAL **$40**

FLUORESCENT LIGHTING

12V-350V DC-DC CONVERTER (with larger MOSFETS) plus a dimmable mains operated HF ballast. These will operate a 32-40W fluorescent tube from a 12V battery. Very efficient. See June 95 EA, **$36** for kit and ballast.

GEIGER COUNTER

NEW Ready made Geiger counters detect dangerous Beta and Gamma rays. Includes 2-mode LCD display, alarm buzzer, 9V battery operation (15mW!). Complete unit **$99**

MISCELLANEOUS

MAGNETIC CARD READERS back in stock **$80**

NEW **12V STEPPER MOTORS** type M-17 20 steps per rev, 55gcm holding torque, 740PPS pull in freq, 100PPS driving freq, 34gcm pullout torque, 6 wire, 100 ohm winding. **Type M-18:** 100 steps per rev., 1500gcm holding torque, 440PPS pull in freq, 300PPS driving freq, 980gcm pullout torque, 6 wire, 10 ohm winding. *INTRODUCTORY PRICE* **$10**

PELTIER DEVICES Solid state, can be used to make a thermoelectric cooler - heater. Basic information included. 12V-3.4A **$25** 12V-4.5A **$35**
We can also provide two thermal cut-out switches and a 12V DC fan to suit either device **$10**

LCD CHARACTER DISPLAYS standard 16 x 1 display, 5V **$20**

IEC EXTENSION LEADS: 2m, with IEC plug and IEC socket **$5.**

3" CONE TWEETERS Sealed back dynamic 8 ohm tweeters: **$5**

12V FANS Brand new 80mm, 12V 1.6W DC fans. **$10 ea or 5 for $40**

STEPPER MOTORS 6V 6 wire 1.8 deg, used **$4**

WELLER SOLDERING IRON TIPS New soldering iron tips for low voltage Weller soldering stations and mains operated Weller irons. Mixed sizes and temperatures. Specify mains or soldering station type: **5 for $10.**

LIGHT MOTION DETECTORS Small PCB assembly based on a ULN2232 IC. Can detect humans crossing a narrow corridor at up to 3 metres **$5** or **5 for $20**

12V-2.5W SOLAR PANEL

US amorphous glass solar panels only need terminating and weather proofing. Includes clips and backing glass. Very easy to complete. Size: 305x228mm, Voc 18-20V, Isc 250mA. *SPECIAL!* **$20 ea. or 4 for $60.** A very efficient switching regulator kit is also available: Suits 12-24V batteries, 0.1-16A panels, **$27**. Also available, a simple and efficient shunt regulator kit, **$5.**

LENS & PHOTOGRAPHICS

SLAVE FLASH - very small, simple and effective. Triggers remote flashes from camera's own flash, to fill in shadows. Does not false trigger, but is very sensitive. Can be used in large rooms. PCB and components kit. **$7**

NEW **SOUND ACTIVATED FLASH** Adapted from ETI Project 514. Adjustable sensitivity & delay enable creation of fascinating photographs. Has LED indicator for easy setting up. PCB, components and microphone. **$13**

PROJECTION LENS Brand new, precision angled projection lens. Overall size 210x136mm. High-impact Lexan housing with focal length adjustment. When disassembled yields three 4" diameter lenses convex-concave, convex-convex, concave. Very limited quantity. **$35**

TOMINON HIGH POWER LENS These 230mm (1:4.5) lens have never been used. They contain six coated glass lenses, symmetric, housed in a black aluminium case. Scale range is from 1:10 through to 1:1 to 10:1. Applications include high quality image projection at macro scales, and portrait photography in large formats. **$45**

USSR LENS 100mm/f2 Pentax screw mount, for night viewers, has focus adj, but no iris adj **$60**

USSR LENS 58mm/f2 Pentax screw mount, used for cameras, has focus and iris adj **$60**

PRECISION FRONT SURFACE ALUMINIUM MIRRORS 200 x 15 x 3mm **$3** 50 x 72 x 3mm **$3**

PORRO 90deg PRISM makes a rainbow from white light **$10**

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NEW Ready made PIR detector module and learning remote control combination can trigger any domestic IR remote controlled VCR to *RECORD* human activity within a 6m range with an 180º view. Starts VCR recording at first movement and ceases recording a few minutes after the last movement has stopped. Just like commercial CCD-video recording systems costing $1000's!! No connection needed to your existing VCR. IR detector module, control kit, IR learning remote control and instructions **$90** or **$65** when purchased with our CCD camera. Previous CCD camera purchasers can claim reduced price with proof of purchase.

TINY PCB CCD CAMERA with auto iris lens, 0.1lux 320k pixels, IR responsive, has 6 IR LEDs on PCB, almost matchbox size! **$199**

OATLEY ELECTRONICS

PO Box 89, Oatley NSW 2223

Phone (02) 9579 4985

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